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BY

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# PREFACE.

This little work, upon the elements of science, is put forth to supply a blank long felt by many teachers—the want of a class-book upon what has usually been called "Common Things," arranged upon some given plan, or system.

It has been the aim of the author to indite the work in plain and simple language, such as most children can understand: at the same time childish language has been avoided, the practice of using such being silly in a teacher, and degrading to a child.

Great care has been bestowed in framing both question and answer, making the question as pithy as possible, and never giving "Yes" or "No" as an answer, such answers being of little practical use.

Attention is called to the introductory portion; a little enterprise and skill on the part of the teacher, will very speedily convince the most doubtful, or unbelieving, that children have not only minds, but that they

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take pleasure in using them, by judging and reasoning r themselves, when knowledge is imparted by comon sense instead of by the rigid rules, furrule, and forms of an ancient pedagogue.

NEW YORK, May, 1859.

# INTRODUCTION.

In teaching the elements of science to children, two very essential portions of the art must be put in practice, for, if neglected, such teaching, if it deserve the name, must prove a sham and a failure.

A number of objects must be collected and placed on a table before the teacher and pupils.

The names of the qualities of an object, and the definitions of them, should always be written upon a black-board; by a pupil, if any are capable of doing so, if not, by the teacher.

This is of primary importance, for all knowledge consists of a right understanding of words, and the proper use of them.

The vast utility of a clear and distinct understanding of the elements, or definitions of any branch of knowledge, must be well known to every practical teacher and the want of such correct teaching is often felt by sad experience in the after life of the pupil.

That teaching from objects is the true system of instructing children in the rudiments of science, must be evident to every reflecting mind: for as the first lesson taught to an apprentice must be the names, uses, and application of the various tools with which to work out his craft; so the names and meaning of the ordinary qualities of matter should be explained and illustrated by example, and the more so as those qualities have but a relative signification. It is also proved by the avidity with which most children will seize upon some new object that is presented to their notice, in order to discover some particular quality in which it differs from other objects with which they are familiar.

This method of teaching is but calling into action one of the most deeply-rooted attributes of man—curiosity—which, managed by a skillful teacher, will give animation to the dullest, and fix the attention of the most restless; in fact, it is the method to develop the perceptive faculties of a child, which should be the great object of all teaching.

It may be said that this method of teaching occupies too much time. It is time well spent, because profitably spent; the lesson thus learned will never be forgotten, because it will be understood, and therefore it will be a pleasure. Nothing so much repels the mind of a child as profitless labor; it becomes disgusted with a study, the first elements of which it can not understand.

This method of instruction should be commenced by comparing one object with another with respect to shape, color and structure.

Thus: one is square, another round, another cylindrical, and so forth; but the terms used must always be explained thoroughly from the various specimens before the pupil.

The same process must be gone through with the colors and modifications of colors.

Then those of structure, as solid, hollow, porous, crystalline, fibrous, and others. Also of appearance, as bright, dull, opaque, transparent, translucent, elastic, and so on.

All those qualities must be made manifest to the eye from objects.

The next step should be the classification of the objects into three divisions. It must be shown that all substances belong to one of three classes, animal, vegetable, or mineral, and why, what an animal substance is, what a vegetable substance is, and what a mineral substance is.

Then, the teacher holding up an object, asks, *To which class does this belong?* and so through the whole number of objects on the table.

When the pupils are sufficiently acquainted with this detail, one of them may be called out in order to separate and arrange the objects into the three several divisions or classes, always naming the object and the division to which it belongs. Thus: *This is a nail; it belongs to the mineral division.*

When the class has become familiar with this branch of the subject, the next step will naturally be to separate the objects into the two great classes of matter, organic and inorganic substances.

There can be no practical difficulty in explaining and making clear to children the terms organic and inorganic. Take the leaf of a plant, and, holding it up to the light, they will at once perceive a main artery running from the stem of the leaf to the point, secondary ones starting from that at right angles, and still minor ones shooting from them in all directions. These are organs through which the sap flows to feed and sustain every portion of the leaf. If the leaf be broken from the plant the supply of sap is cut off, and the leaf withers and droops away; those little veins or pipes are the organs by means of which life is carried on.

Or take the bud from a tree during winter. Here is life in embryo, the scales that cover it protect the tender leaf from the nipping frost. Unfold the covering and there may be seen the tiny leaves ready to clothe the tree with living beauty as the warmth of the season advances. Again, it may be explained from the body, the veins are organs through which the blood flows to supply the skin, flesh and bones with nourishment. Should a string be tied around the finger the circulation of the blood is arrested; at first a painful feeling is experienced, then a deadness is felt, and the finger loses its natural color; remove the string and at first the reaction causes a painful sensation, after which a certain warmth ensues from the rapidity with which nature resumes her operations.

From the vital action of those veins, the hand and body increase in structure and development.

A slate has no such organs; it remains ever the same.

The next step is to classify the objects into two divisions, natural and artificial, and the reason.

When these preliminary steps are fully overcome, the course of instruction is to be commenced by taking up any two objects and comparing them.

instance, a piece of coal and a piece of

*What color is this piece of coal?*

Black.

*What color is this piece of glass?*

White.

*Can you see through coal?*

No; it will not admit light.

*What name is given to that quality?*

Opaque, that is, light can not pass through it.

*Can you see through glass?*

Yes; objects can be seen through it.

*What name is given to that quality?*

Transparent, because objects can be seen through it.

Those words are then written upon the blackboard and defined. Thus:

Coal is

Black, a dark, gloomy color, the darkest color.

Opake or opaque, not admitting light.

Glass is

White, the lightest color, or without color.

Transparent, something that can be seen through.

Other objects are then taken up to discover whether any of them possess those qualities in the same degree.

A lesson can then be derived from those words. Thus:

*What words commence with black?*

The word black is written up and others derived om it.

Black, a dark, gloomy color.
——bird,
——fish,
——berry,

Blackboard,
——lead,
——smith.
Transparent, to be seen through.
*What does the word* trans *mean?*
Over, through, or across.
*What words begin with* trans?
*Trans*parent,
*Trans*port,
*Trans*gress,
*Trans*fer,
*Trans*plant,

or some others that may arise at the time.

The words can then be put into short sentences, as
"Water is transparent."
"He transgressed the law."
"He was transferred from one class to another."
"Trees are transplanted."

With the names of qualities that are of Saxon origin, but little difficulty will be experienced, for, being primitive words, they convey their own meaning, as bad, good, heavy, brown, round, sweet, etc., but most of our scientific words are not derived from that source; they are borrowed from foreign languages. But no serious difficulty has been felt in teaching the terms used in geography, grammar, arithmetic, or algebra; yet those terms have been derived from the same source.

There can be no more trouble in teaching from an object the meaning of the word fibrous, or crystalline, than exists in teaching the word isthmus, or peninsula, If a piece of string and a piece of glass be examined by the class, the import of those words can be speedily and effectually shown. Thus:

Fiber, a thread.

Fibrous, composed of threads.

Crystal, a hard, bright substance, having a given number of sides.

Crystalline, formed of crystals.

Here various objects can be shown to illustrate the word fibrous; as, silk, muslin, cloth, ratan and meat are fibrous substances; and salt, sugar, quartz, cast iron, are crystalline ones.

When the terms used in the previous lesson are understood, other qualities akin to those already found may be introduced; thus, a piece of paper, or of ground glass is not transparent, but it will admit light.

The name of this quality is written

Translucent, admitting light; or,

Semi-transparent, half transparent.

*Semi*, half.

Semi-annual,
——circle,
——colon.

Thus, by degrees, an intelligent teacher will soon carry the class far enough to discover the qualities of substances so far as they can be detected by the eye, such as those of color, form or construction, and to understand, and apply the words. But all this can not be written in a book, nor need it be; for at this stage, both teacher and pupil will be more successful if left to their own resources.

We will now suppose that the task is accomplished of detecting form, color, structure, and the various parts of the object by the eye. The lesson upon a cent would then stand thus:

A cent is
Round, circular.
Brown, a dark color formed by mixing red and yellow.
Metallic, formed of metal.
Solid, the same all through.
Crystalline, formed of crystals.
Bright, reflecting light.
Artificial, made by art.

Parts of a cent.
Effigy, the image.
Reverse, the opposite side.
Superscription, writing above.
Design, wreath inclosing the word "cent."
Name, value of the coin.
Date, when it was made.

*Super*, over, or above.
Superintendent, one who oversees.
Supervisor, one who overlooks.
Superb, above ordinary beauty.
Superficial, above the solid parts, outside.
Superfine, above the common texture.

This method of forming words from a prefix, or other principal part of a word, should be frequently practiced. It is not only a very pleasing exercise, but it is one of extreme value for after purposes.

Of necessity there can be but few such examples written here, but the teacher can always select a few appropriate words from such a work as Oswald's Dictionary, which is to be found in every school.

When the eye is so far instructed, another step can taken, to discover the qualities manifested to the e by experiment.

Thus the cent not only possesses the above qualities but it is

Malleable, can be beaten out by hammering.
Ductile, can be drawn out into wire.
Fusible, will melt, or mingle together.
Heavy, sinking in water.
Tenacious, tough, strong, bearing a great weight.

*Mall*, a hammer.
Mallet, a wooden hammer.
Maul, to beat with a cudgel.

Duct, from *duco*, to lead.
Duct, a pipe to lead a fluid.
Duke, a leader.
Induce, to lead away.
Educate, to lead up.
Education, the act of leading.
Conduce, to lead by argument.

*Fundo, fusum*, to melt or to pour.
Fusible.
Fuse, to melt.
Confuse, to melt, or mingle together.
Diffuse, to pour abroad.
Infuse, to pour into.
Refund, to pour back again.

After the qualities that are found by means of the eye are all discovered, those that affect the other senses may be taken up.

Thus, keeping to the cent, it is
Sonorous, having a sound.
Odorous, having a scent or smell.
Poisonous, destructive of life.

*Sonus*, a sound.
Sonnet, a song having a sweet sound.
Resound, to sound back again.

Odor, a smell.

It will be needless to enter more fully upon the system of deriving words from a root, as that is not the intention of this book. Enough has been shown to mark out the plan to develop the thinking powers of children to the exercise of this very important subject; in fact, of itself, it is an element of science.

Now take an object possessing some very opposite qualities from the last one shown; say a cent and a piece of sponge.

The cent is solid.

The sponge is porous, absorbent, and elastic; those qualities shown to the eye, possess all the elements of truth, because they carry conviction. For instance, the sponge is squeezed up and placed upon the table, when it soon regains its former shape and dimensions.

It soaks up water.

It is full of little holes, etc.

Whalebone is elastic.

Chalk is friable, but glass is brittle; and so objects [illegible] be compared by the teacher in a way to suit the [illegible] the moment.

## A QUILL.

Lectures, or rather some familiar talk, of short duration, can be given from objects. Take a quill, for instance, and from it can be shown how nature can combine great strength with extreme lightness; the small feathers running from the shaft are all turned one way to present a solid sheet with which to beat the air, while each one is locked to the next by little hooks, which, should they be rent asunder, no art can again join.

The quill is a pipe, or cylinder, that it may possess all the strength of an arch, and that no more material may be used than is absolutely necessary, so that the bird may have to carry no more weight in its flight through the air than is compatible with its safety.

## A COCOA-NUT.

This cocoa-nut is the fruit of a tree peculiar to the low, sandy shores of the tropical seas. The nut itself drops off when ripe, and in doing so frequently falls into the water by which it is carried to other parts and deposited in land suitable to its growth.

The fruit of the nut, as you know, is inclosed in a heavy, hard, brown shell, which will sink in water, but the hard shell itself is enveloped in a thick mass of light fibers which overcome the weight of the nut, and thus prevent it from sinking; but as this light material upon being soaked with water would lose its buoyancy, and as salt water is fatal to the life of most seeds, the whole is inclosed with a highly enameled covering through which no water can penetrate.

Looking at the shell, it is found to consist of a solid globular substance through which no sprout can force its way, but upon looking more closely, there will be found three spots resembling the face of a monkey. Those spots are covered with a substance much softer than the shell itself, and which is easily dissolved by the action of heat and moisture. Through those eyes the germ of life springs from which the root and branch of the plant are developed.

## A BONE.

Looking at a bone is a business that, at first sight, offers but few inducements, yet upon consideration it displays the wisdom of the Great Creator in a very pleasing and instructive form. Taking the leg bone of the sheep, or the ox, it is seen to be made in a cylindrical form and filled with marrow. It is thick, of a dull appearance, and of great strength.

The leg bone of a bird is of a similar shape, and hollow, but the marrow is wanting: an oily substance takes its place. But it is of a much finer texture, harder, thinner, and much more brittle.

The bone of a fish is very different. Alike solid throughout, there is no receptacle for marrow; very elastic, it can be bent backward and forward without breaking.

The leg of the ox and sheep is formed for carrying the whole weight of the body through all the evolutions of the animal—walking, running, leaping. The bones are made hollow to give the greatest strength possible for the quantity of material used, so that the animal may not have to carry a greater weight than is absolutely necessary.

They are filled with marrow to deaden the shock, or jar, upon the hollow bone by springing or jumping, or during other violent exercises.

The bone of the bird needs no such construction. It is formed for rapid flight through the air, therefore extreme lightness with sufficient strength is the object to be attained. What the bone wants in thickness it gains in fineness, and therefore in strength, and if it becomes more brittle in consequence, that fact interferes but little with the arrangement, for the bird has no violent exercise on the land; for the same reason no marrow is needed; moreover, the wing bones are much stronger, and more complicated than those of the leg, for obvious reasons.

The bone of a fish differs from both, because its habits differ. Living in a medium of the same density as its own body, the fish has no obstacles to resist or overcome in its passage through the water. Having no weight to carry or support, it never tires, but keeps in endless motion. Yet it must descend to great depths, and ascend again. Were its bones as brittle and hollow as those of a bird, the increasing weight of the waters upon its body in descending would crush them, and the fish would be destroyed; but soft and pliable as they are, they accommodate themselves to every circumstance of the creature's life, and their pliability enables them to move with the greatest facility through the water.

## LIME.

This useful material is found in every part of the earth, and in such quantities that it is supposed to form fully one third of the solid contents of the globe.

It is never found pure, but takes every form in inorganic nature, as rocks, mountains, and mines of marble, chalk and other minerals. It enters also into all the combinations of animal and vegetable substances.

It is the principal ingredient in the bones of animals. The coral insect throws up mountain ridges of it from the bottom of the ocean. Those ridges or reefs in the Pacific ocean extend for many thousand miles; in fact, most of the islands in that vast body of water, have been thrown up by those tiny insects.

Shells of every kind are formed of lime; and hair, horn, nails, scales of fishes and of serpents, all contain a portion in the same degree.

Every part of the body contains a portion, even the eye. Take the eye of a fish, and in it will be found a little, round, perfectly transparent piece of jelly. Place it on fine print, and the letters will appear much larger. It is a lens.

Boil the lens in water and it becomes one of the toughest and most opaque of substances. This, in a great measure, is owing to the lime it contains.

## SALT.

Many are the useful products that the ocean administers to the wants of man, but none are of more pri- importance to him than salt.

It preserves his health, by destroying much that would otherwise injure; it performs the same office for his domesticated animals—the faithful slaves of his will—and greatly assists him in accomplishing their subjugation. Thus the immense droves of half-wild cattle that roam over the vast plains of South America, will at certain periods return to their homes to obtain this substance, which the instinct of their nature has taught them is necessary for their welfare by destroying the internal parasites that, without it, would prey upon their vitals.

It assists the farmer in the cultivation of the soil, by destroying many insects that would injure his crops; by adding much useful matter to the land; and by hastening the decay of animal and vegetable remains upon which much of the fertility of the land depends. It allows the merchant to carry on his traffic with distant lands, for without it provisions could not be preserved, so that no voyage could be made beyond a few miles from the coast, and hence man would be confined to but a small portion of the globe indeed. From it, or from material obtained from it, the chemist extracts his most powerful agent in arresting contagious disease—chlorine—which is contained in salt to the amount of 60 per cent. From the same substance the dyer forms an oxyd which is a mordant for his most brilliant colors, as scarlet, crimson and purple; yet the bleacher, from the same substance, derives a material that deprives vegetable matter of all color. The glass maker obtains from salt the soda with which to fuse the otherwise infusible silex, while the glass painter by the aid of chlorine, forms the richest tints wherewith to ornament that beautiful material.

Thus we see that salt administers to the wants, comforts and luxuries of man in all departments of life. It destroys many of the pests that annoy him and injure his property. It keeps his cattle in health, and preserves their flesh when dead. It will penetrate through the hardest fiber of flesh, yet the creatures that pass their lives in an ocean of brine, are the freshest to the taste, and the freest from salt.

## GLASS.

The sand on the floor is nearly pure silex, or quartz, won from the rocks, and reduced to powder by the violent action of the waves of the sea. This substance alone is infusible in the strongest fire, but when mixed with soda the two will melt together and form glass.

This beautiful material, glass, when cold, is the most brittle of all substances, but when fused it is one of the most flexible. It can be twisted into any shape, blown, cast, or molded into any form that may suit the wants or the whims of the workman. It will resist the action of the weather, and of all the acids except one, and that a very rare one indeed; it will resist the action of time itself, for we have specimens, from the ruins of cities that existed three thousand years ago, that are as fresh and perfect as though they were made but yesterday.

[illegible] transparency renders it a matchless substance for our windows, for while it excludes the weather, it admits the rays of light, and a perfect view of exterior objects. It being a non-conductor of electricity, makes it perfect as a supporter for the telegraph wires. Its indestructible qualities render it indispensably necessary for making bottles in which can be preserved alike the strongest acids and the mildest and most delicate fluids.

Its peculiar faculty of condensing the rays of light, has enabled man to bring distant objects near to his gaze, and has thus assisted him to achieve the greatest conquests of his existence by means of the telescope and microscope; and lastly, from the almost valueless materials from which it is made, it can be applied to an almost endless variety of purposes.

## BARK OF A TREE.

The bark of a tree, like the skin of an animal, is given to it as a protection against the changes of the weather. The outside of the bark, like the hair of animals, can be cut without injury, but the interior bark, when wounded, heals by the same process as a deep cut through the skin of an animal; it leaves a rude mark on the surface; nor can a tree live that is stripped of its bark any more than an animal that is stripped of its skin.

Bark is a light, spongy, porous substance, and therefore is a very bad conductor of heat; that is, it becomes hot very slowly, but when once hot, it parts with the heat quite as slowly, and therefore it is an admirable defense for the tree against sudden changes from hot to cold weather.

The further we proceed north the colder it becomes in winter, and the fewer become the number of trees: among the last found is the fir. This, of all the trees, has the thickest bark. Some of them in the northern parts of America have bark a foot thick. This occurs only with large trees, for the larger the tree, the more surface there is to be protected.

But the bark performs another office for the tree; it conveys the sap from the leaves back to the root, fitted to form wood, flowers and fruit. This sap has ascended up the center and body of the tree, and through the branches and twigs to every leaf where it becomes exposed to the action of the air, for the leaves of a tree perform the same office for the tree that the lungs of an animal perform for the animal — they breathe the air.

The bark of many trees is very useful. Cork is the bark of an oak tree that grows in France and Spain. It is used for many purposes, for which it would be very hard to find a substitute.

The skins of animals are changed into leather, by means of bark, and for this purpose the bark of the oak, hemlock and birch, is used, and the quality of the leather depends in a great measure on the kind of bark used. Thus the skin of the hog, which when tanned is made into saddles, and of the ox, which is made into sole-leather, are tanned with oak; inferior leathers are tanned with hemlock, or sumach. Fine [illegible]ers, with which the best books are bound, are tanned with birch bark, and Russia leather owes its peculiar odor to the nature of the birch bark with which it is tanned.

Cinnamon, which is greatly used to flavor food, is the bark of a tree found in some of the islands of Asia, and Peruvian bark, which cures man of the ague, is the bark of a tree growing in South America

## THE HAND.

The human hand is said to be the master work of nature. With it we supply the wants of most of our senses, and so obtain a knowledge of the properties of matter; with it we find whether a substance is hot or cold, soft or hard, heavy or light, rough or smooth. In fact, without the hand we should be deprived of half our enjoyments.

In its structure are employed a greater number of bones than there are in any other portion of the body, that it may possess greater freedom of action than any other. It is the most sensitive to the touch, and yet can be used more freely without injury than any other member, because it is the one the most used to supply our wants. It is the most exposed, yet suffers the least from disease or cold.

The hand is formed for grasping, lifting and holding —the joints of the wrist and fingers are capable of every movement known in machinery, and the ends of the fingers are protected by a substance, the like of which is not found in any other portion of nature. The nails, which protect the ends of the fingers, giving them beauty of appearance and fitness for use, consist of an ever-growing substance that in itself has no feeling, so that it can be cut and kept within proper bounds; yet it is soft and flexible, and full of life, that it may accommodate itself to every movement of the most sensitive organ of touch. Had the finger nails been formed of a substance as hard as the teeth, they could not have been elastic and yielding, but hard and brittle, and thus would have become broken and painful upon the slightest injury.

The foregoing are but a few hints thrown out, roughly hewn, but suggestive of a system within the reach of every teacher who wishes to make teaching the art it professes to be—that of developing the intellect of children.

# MOORE'S ELEMENTS OF SCIENCE.

## LESSON I.

*Q. Of what is the earth formed?*
A. Of matter or substance.

*Q. What is matter?*
A. A thing that can be weighed and measured.

*Q. Is a piece of wood, or a stone matter?*
A. Yes, they have all the qualities of matter

*Q. Why?*
A. Because they occupy space and have weight.

*Q. What is meant by space?*
A. The room a body takes up.

*Q. Can a piece of wood be measured?*
A. Yes, it has length, width and thickness.

*Q. What general name is given to those dimensions?*
A. They are called properties, or qualities.

*Q. Does matter possess any other qualities?*
A. Yes, many others.

*Q. What is the chief quality of sugar?*
A. Sweetness.

*Q. Of vinegar?*
A. Sourness.

## LESSON II.

*Q. Is sweetness a substance?*

A. No, it can not be measured.

*Q. Is color a substance?*

A. No, it is only a quality.

*Q. Why is it not a substance?*

A. Because it can not be weighed or measured.

*Q. How do we discover the properties of matter?*

A. By means of the senses.

*Q. What are the senses?*

A. Organs of the body by which impressions are conveyed to the mind.

*Q. How many senses has man?*

A. Five; seeing, hearing, tasting, feeling and smelling.

*Q. What is the organ of sight?*

A. The eye.

*Q. Where are the eyes placed?*

A. Always in the front of the head.

*Q. Why is that?*

A. To allow the greatest extent of vision possible.

*Q. How are the organs of sense formed?*

A. Always in pairs, except the organ of taste.

*Q. What do you mean by pairs?*

A. Two eyes, two ears, two hands and two nostrils.

*Q. Are both eyes and both ears alike sensitive?*

A. Yes; there is no distinction between them.

## LESSON III.

*Q. What is the organ of taste?*

A. The tongue.

*Q. Have all animals the sense of taste in the same degree?*

A. No, many birds and fishes, swallow their food whole.

*Q. How are the tongues of birds and fishes formed?*

A. They are hard and horny, and are capable of but little motion.

*Q. What is the organ of hearing?*

A. The ear.

*Q. Are the ears of all animals formed alike?*

A. No, the most timid have the largest ears.

*Q. Which has the larger ear, the cat or the rabbit?*

A. The rabbit.

*Q. Why is that?*

A. The rabbit is the most defenseless.

*Q. Which can move its ears with the greatest freedom?*

A. The rabbit can move them in every direction.

*Q. For what object?*

A. That it may catch the first sound of danger.

*Q. Have all animals ears?*

A. No; fish and most reptiles have no external ears, while many classes of animals are incapable of hearing at all.

*Q. Can all animals see?*

A. No; many pass their existence in situations where eyes would be of no use to them.

## LESSON IV.

Q. *What is the chief organ of feeling?*
A. The ends of the fingers, in man.

Q. *Does the organ of feeling vary in some animals?*
A. Yes, with many it is the nose, while birds feel with their feet.

Q. *What qualities are detected by the eye?*
A. Those of form and color.

Q. *What by the touch?*
A. Those of temperature and hardness.

Q. *What by the ear?*
A. Those of sound.

Q. *In what creature are the senses fully developed?*
A. In man only, in whom they all exist in the greatest perfection.

Q. *In what degree are those senses developed?*
A. They descend in degree, intensity and number, as we descend in the scale of creation.

Q. *Which is the sense that always exists?*
A. The sense of touch. It is the first to appear, and the last to depart. It is the sign of existence.

## ELEMENTS OF MATTER.

## LESSON V.

Q. *Are all substances exactly alike?*
A. They are not; no two substances are alike.

Q. *Why is that?*

A. Because they are not formed of the same materials.

*Q. In what does a piece of glass differ from a piece of charcoal?*

A. In appearance and in use.

*Q. How do they differ in appearance?*

A. Charcoal is dark, opaque and light; glass is bright, transparent and heavy.

*Q. How do they differ in use?*

A. Charcoal is chiefly used for fuel; glass is used for glazing windows, making bottles, etc.

*Q. Do they differ in other respects?*

A. Yes; charcoal is a simple substance; glass is composed of several such substances.

*Q. What is a simple substance?*

A. One that consists of but one material.

*Q. What is such a substance called?*

A. An element.

*Q. What is that?*

A. One that art can not reduce to a simpler form.

*Q. What is meant by art?*

A. The skill of man.

## LESSON VI.

*Q. Is iron a simple substance?*

A. Yes, it is called a simple substance.

*Q. Why?*

A. Because it can be melted and acted upon in various ways, and yet remain iron.

*Q. Is wood a simple substance?*

A. No; it is composed of several simple substances.

*Q. Can you name them?*

A. The principal are carbon, oxygen and hydrogen.

*Q. What is carbon?*

A. We are most familiar with it in the shape of charcoal.

*Q. How is it obtained?*

A. It is the remains of wood burned in a close vessel.

*Q. What is the meaning of the word carbon?*

A. A coal.

*Q. Is carbon a simple substance?*

A. Yes; art has not been able to reduce it to a simpler form.

*Q. What is the chief quality of charcoal?*

A. It is inflammable.

*Q. What is the meaning of inflammable?*

A. Capable of burning, or supporting fire.

## LESSON VII.

*Q. Can you name any other substances that are inflammable?*

A. Yes; turpentine, oil, alcohol, and coal.

*Q. Why are they inflammable?*

A. Because they contain much carbon.

*Q. Are any of the other elements inflammable?*

A. Yes; hydrogen, phosphorus, and sulphur

*Q. How many descriptions of charcoal are there?*

A. Three; animal, vegetable and mineral.

*Q. From what is animal charcoal obtained?*
A. From the bones of animals.

*Q. Mineral charcoal?*
A. From bituminous coal.

*Q. How is charcoal obtained?*
A. By calcining the material from which it is obtained.

*Q. Are all the elements mingled with other materials as generally as carbon is?*
A. Yes; they mingle with each other in every form and degree.

*Q. Do any of them exist in a state of purity?*
A. A few of the metals do so in small quantities.

*Q. What is the character of the elements?*
A. They are all violent poisons.

## LESSON VIII.

*Q. How many elements are there?*
A. Fifty-four are known to exist, but some suppose their number to be sixty.

*Q. Of what do the greater number consist?*
A. Of metals.

*Q. How many metals are there?*
A. Forty-two, or, as some say, forty-nine.

*Q. Are they all in common use?*
A. No; many of them are extremely rare.

*Q. Of what do the remaining elements consist?*
A. Of solids and gases.

*Q. Which of them are solids?*
A. The principal of them are carbon, sul

phosphorus, and the bases of lime, soda and quartz.

*Q. Which of them are gases?*

A. Oxygen, hydrogen and nitrogen.

*Q. What is a gas?*

A. A substance whose parts, when unconfined, separate like smoke from a pipe.

*Q. Are the gases visible?*

A. No; they can not be seen.

*Q. How, then, do we know that they exist?*

A. Because they can fill a space.

*Q. Can you give an instance?*

A. A bladder can be filled with air.

## LESSON IX.

*Q. Is air a gas?*

A. Yes; it is a mixture of oxygen and nitrogen gases.

*Q. In what proportion are those two gases mixed?*

A. Four fifths of nitrogen, with one fifth of oxygen.

*Q. Does this proportion always exist?*

A. Yes; at the level of the sea, and at the top of the highest mountain, in every clime and at every season.

*Q. What is the meaning of oxygen?*

A. Acid, or to generate acid.

*Q. Can an acid exist without the presence of oxygen?*

A. No; oxygen is the principle of all acids.

*Q. What are oxydes?*

A. Rusts of metals, salts, etc., which contain oxygen.

*Q. What is the meaning of hydrogen?*
A. Water, or creating water.

*Q. Why was it called by this name?*
A. Because water is composed of a large proportion of this gas.

*Q. Can you name any words that commence with* Hydro, *and tell their meaning?*
A. Yes, many; as ——

*Q. To what use do we apply hydrogen?*
A. For giving artificial light.

*Q. Is hydrogen inflammable?*
A. It is very inflammable when mixed with air.

*Q. Is there danger from collecting this gas in reservoirs?*
A. No; if a lighted torch were introduced into a reservoir of gas, it would be at once extinguished.

## LESSON X.

*Q. From what substances is hydrogen gas obtained?*
A. From bituminous coal, rosin, wood, and other substances of vegetable orgin; also from animal oils.

*Q. By what process are they treated to obtain this result?*
A. By destructive distillation by fire.

*Q. Can hydrogen be obtained by any other means?*
A. Yes; pure hydrogen can be obtained by disengaging it from water.

*Q. How can this be performed?*
A. By filling a bottle half full of

*Q. What is the standard for gases?*
A. Common air.

*Q. How much does a pint of water weigh?*
A. One pound.

*Q. How much does a pint of iron weigh?*
A. Seven pounds.

*Q. A pint of quicksilver?*
A. Thirteen pounds.

*Q. A pint of gold?*
A. Nineteen pounds.

*Q. Are there any substances lighter than water?*
A. Yes; many.

*Q. What are they?*
A. Those that will float on water.

## LESSON XII.

*Q. Why does a balloon ascend through the air?*
A. Because it is filled with a gas which is much lighter than air.

*Q. What is the weight of this gas?*
A. Fifteen times lighter than common air.

*Q. What is this gas called?*
A. Hydrogen, which is the lightest of all known substances.

*Q. How do we know it to be a substance?*
A. Because it will fill a space.

*Q. How can air be weighed?*
A. A given quantity is forced by means of the air-pump into a vessel, and then weighed like any other material.

*Q. What is the weight of a substance called?*
A. Its specific gravity.

*Q. Which is the heaviest substance known?*
A. A metal called platina, or little silver, as it was named by the Spaniards who first found it in South America.

*Q. Why does a cork float?*
A. Because it is so much lighter than the same bulk of water.

*Q. Why does an iron ship float?*
A. Because, it being hollow, it occupies a much larger space than a quantity of water of equal dimensions.

## CLASSES OF MATTER.

### LESSON XIII.

*Q. How is matter separated?*
A. Into two great divisions.

*Q. What are they called?*
A. Organic and inorganic matter.

*Q. What is an organic substance?*
A. Part of an animal or a vegetable.

*Q. What is an inorganic substance?*
A. It is a mineral, as a stone or a metal.

*Q. When a leaf is held to the light, what is seen?*
A. Veins running through it in every direction.

*Q. What do the veins do?*
A. They convey the sap to all parts of the leaf.

*Q. What name is given to those veins?*
A. They are called organs.

*Q. Do they exist in other parts of the plant?*
A. Yes, in every part.

*Q. Why does the finger bleed when it is cut?*
A. Because some of the organs are severed.

## LESSON XIV.

*Q. Has a metal or a rock such veins?*
A. No; they are inorganic, or without organs.

*Q. In what else do they differ?*
A. An organic substance lives, grows, decays and dies; an inorganic substance always remains the same.

*Q. What is an organic remain?*
A. A petrified, or dead substance, that once formed a portion of a living body, either animal or mineral.

*Q. Which is the more useful of the two classes?*
A. The organic.

*Q. Why?*
A. Because it supplies man with food and clothing.

*Q. Upon what do all animals feed?*
A. Upon organic matter.

*Q. Is charcoal organic?*
A. No; it is the remains of an organic substance.

*Q. Why is that?*
A. Because the fire has destroyed the organization of the wood.

*Q. Can an animal live on charcoal?*
A. No; no animal can subsist on it.

*Whence do vegetables obtain nourishment?*

From inorganic substances.

*What of those substances?*

The soil, air, and light.

## LESSON XV.

*[illegible] do vegetables perform in nature?*

[illegible] inorganic matter into or- [illegible]

*[illegible] accomplished?*

[illegible] the roots and leaves.

*[illegible] made?*

[illegible] small.

*[illegible] materials of which clothing is* [illegible]

[illegible] flax, fur and skins.

*[illegible] substances?*

[illegible] skins.

*[illegible] substances?*

[illegible]

*[illegible] commonly?*

[illegible] been with a [illegible]

[illegible]

[illegible] composed of the [illegible] elements.

*[illegible]?*

[illegible] nitrogen.

*[illegible]?*

[illegible] nitrogen.

*Q. What other animal substances are chiefly composed of those two materials?*

A. Horns, hoofs, nails, hair, the scales of fishes and serpents.

## DIVISIONS OF ORGANIZED MATTER.

### LESSON XVI.

*Q. How is organized matter divided?*

A. Into two divisions, animal and vegetable.

*Q. What is an animal?*

A. A living creature that has the sense of touch, has a stomach, and can generally move about from place to place.

*Q. Have all animals the power of locomotion?*

A. No; oysters and some other shell fish are incapable of changing their locality.

*Q. Are any of the animal tribes fixed to the earth?*

A. Yes; some of the lower types of marine animals are fixed to the rocks by a root.

*Q. How can the dried remains of such animal substances be distinguished from vegetable matter?*

A. By burning, the animal product singes away with a smell like burnt wool; the vegetable burns like paper.

*Q. What is a vegetable?*

A. A living substance fixed to the ground by a root, and is without sensation.

*Q. What part does the stomach of an animal per*

A. It receives and digests food.

*Q. Can an animal live without a stomach?*
A. No; all animals must consume food.

*Q. What is the chief feature of a plant?*
A. Every plant must have a root.

*Q. What office does the root perform?*
A. It is the stomach of the plant.

*Q. Why?*
A. It dissolves and digests the food of the plant.

## HABITS OF ANIMALS.

### LESSON XVII.

*Q. Do all animals eat the same kind of food?*

A. No; some consume flesh only; others live entirely on vegetable food.

*Q. What name is given to those that live on flesh?*

A. They are called carnivora, or flesh-eating animals.

*Q. What name is given to those that live on vegetable food?*

A. Herbivorous animals.

*Q. Which class is the more useful to man?*

A. The herbivorous.

*Q. Why is that?*

A. Because they alone, except the dog, can be domesticated.

*Q. What is meant by domesticated?*

A. Rendered obedient to the will of man.

*Q. Where are animals domesticated?*

A. In every climate.

*Q. What animals are domesticated for labor in hot climates?*

A. The elephant, camel, ox and horse.

*Q. What in temperate climates?*

A. The horse and ox.

*Q. What in cold climates?*

A. The reindeer and the dog.

## LESSON XVIII.

*Q. Is the dog an herbivorous animal?*

A. No; it eats flesh.

*Q. What distinguishes the dog from other of the carnivora?*

A. Its great intelligence, and its attachment to man.

*Q. Where is the dog found?*

A. In every climate; wherever man is found.

*Q. What animal was first domesticated?*

A. The dog.

*Q. What use was then made of him?*

A. To assist in subduing and guarding other animals.

*Q. What are beasts of burden?*

A. Those that carry, or draw loads.

*Q. Which are the principal beasts of burden?*

A. The elephant, camel, horse, ox, and ass.

*Q. Where are mules used for labor?*

A. Chiefly in mountainous countries.

*Q. Why are they used there?*

A. Because they are very sure footed.

*Q. Why are the reindeer and the dog used for labor?*

A. Because, where the practice prevails, no other beast of burden could exist.

*Q. For what reason?*

A. The climate would not supply them with food.

## LESSON XIX.

*Q. Does man eat the flesh of the carnivora?*

A. No; not of those that live on the land.

*Q. Does he eat of those that dwell in the waters?*

A. Yes; fish are all carnivorous.

*Q. Can a carnivorous animal exist on vegetable food?*

A. No; they can not digest it.

*Q. Can a horse or ox eat flesh?*

A. No; the stomach of a horse can not digest flesh.

*Q. What description of food does man consume?*

A. Both vegetable and animal food.

*Q. What name is given to man in consequence of this faculty?*

A. He is said to be omnivorous.

*Q. What is the meaning of that word?*

A. Eating every kind of food.

*Q. Of what advantage is this to man?*

A. He can accommodate himself to, and live in every climate.

*Q. Can man live entirely on vegetable food?*

A. Yes; many millions of people in India rtake of no other description of food.

*Q. Do any tribes live entirely on animal food?*
A. Yes; many tribes on the borders of the Arctic ocean.

## LESSON XX.

*Q. Have all wild animals the same habits?*
A. No; some species live in companies, others live alone.

*Q. What name is given to those that live together?*
A. Gregarious animals.

*Q. What is the meaning of that word?*
A. Living in communities.

*Q. Why do they do so?*
A. To protect themselves from fiercer animals.

*Q. What animals are gregarious?*
A. Mostly herbivorous animals.

*Q. Do carnivorous animals flock together?*
A. Only the smaller ones, that hunt in packs, as jackals and wolves.

*Q. What are the larger and fiercer animals called?*
A. Solitary animals; that is, they live apart, or in pairs.

*Q. Why do they live this solitary life?*
A. Living on prey, they catch their food by stealth.

*Q. Could they not do so in companies?*
A. No; their presence, and odor, would frighten away their victims.

*Q. What would be the result?*
A. The larger beasts of prey would [illegible] come extinct, from starvation.

## LESSON XXI.

*Q. To what is the term herd applied?*
A. To a number of oxen, horses, or elephants.

*Q. What is a flock?*
A. A number of sheep, or geese.

*Q. What is a drove?*
A. A number of animals driven to market.

*Q. What is a pack?*
A. A number of dogs, or wolves.

*Q. What is a covey?*
A. A hen with her chickens, or a few birds together.

*Q. When do beasts of prey seek their food?*
A. Mostly by night.

*Q. What are they called in consequence?*
A. Nocturnal animals.

*Q. What does that mean?*
A. Seeking their food by night.

*Q. How are they enabled to see at night?*
A. By the peculiar construction of their eyes.

*Q. Is a cat a nocturnal animal?*
A. Yes; it pursues its prey by night.

## LESSON XXII.

*Q. What is singular about the eyes of a cat?*
A. The pupil of the eye will expand and contract.

*Q. Can this be seen?*
A. Yes; if a cat be held to the light, the pupil of the eye will appear like a line.

*Q. How do the eyes appear in the dark?*
A. Large and luminous.

*Q. Is the eye of the cat a type of the eye of all the carnivora?*
A. Yes; the eye of all ferocious beasts is formed upon the same principle.

*Q. Why are the eyes of nocturnal animals thus formed?*
A. That the dim and scattered rays of light may be collected into one large focus.

*Q. Are there nocturnal animals in this country?*
A. Yes; among others, owls, bats, and many insects.

*Q. Is a bat a bird?*
A. No; it has nothing in common with a bird except that it flies.

*Q. Upon what kind of food do nocturnal animals live?*
A. They all consume animal matter.

*Q. Where are nocturnal animals chiefly found?*
A. The warmer the climate, the more plenty those animals become.

*Q. Of what color are nocturnal animals?*
A. Of a sad and gloomy color.

## LESSON XXIII.

*Q. Do the same animals remain with us all the year?*
A. No; many remain only during the summer.

*Q. Why is that?*
A. Because the food of many of them fails upon the approach of winter.

*Q. What animals leave us at that season?*

A. Many birds and fishes, frogs, and most insects.

*Q. Where do the birds and fishes go?*

A. They depart for other climates.

*Q. When do they again appear?*

A. When the winter is over.

*Q. What are such animals said to do?*

A. To migrate.

*Q. Can frogs and insects migrate?*

A. No; their powers of motion are too feeble.

*Q. How do they escape from the cold of winter?*

A. Most insects pass their brief existence during the summer months, when they deposit their eggs and die.

*Q. How are frogs and other reptiles protected?*

A. They hybernate.

*Q. What is that?*

A. The powers of life become suspended, and they fall into a deep sleep.

## LESSON XXIV.

*Q. Where do they hide themselves?*

A. Bats retire to caves, or hollow trees, frogs bury themselves in holes, or beneath the mud.

*Q. When do they revive?*

A. With the warm weather in spring.

*Q. Where do animals hybernate?*

A. In extreme climates: either hot or cold.

*Q. In what regions do animals hybernate from the [illegible] of heat?*

[illegible] Humboldt mentions that serpents and other reptiles hybernate in the burning plains of South America.

*Q. At what season do they hybernate?*
A. During the dry, or hot season.

*Q. Why do these animals hybernate?*
A. Because from the severity of the heat their food fails them.

*Q. When do they revive?*
A. When the rainy season commences.

*Q. Why do animals hybernate in cold climates?*
A. For the same reason. If they remained in a state of activity, they would perish for want of food during the cold season.

*Q. Are there any animals that provide for this state of inaction?*
A. Yes; bees, ants, field mice, and some other animals, lay up a store for winter.

## COMPARATIVE SIZE OF ANIMALS.

### LESSON XXV.

*Q. How do animals vary in size?*
A. Some are so minute that they can not be seen by the naked eye.

*Q. How, then, are they seen?*
A. By means of a microscope.

*Q. Where are such animals found?*
A. In stagnant water.

*Q. What are they called?*
A. Animalcula, or little animals.

*Q. Are such little creatures perfect animals?*
A. Yes; they have perfect limbs, circulation of the blood, and digestive organs, and swim about with great swiftness.

*Q. Where is the largest animal found?*
A. In the ocean.

*Q. What is it called?*
A. The whale.

*Q. Is the ocean larger than the land?*
A. Yes; the Pacific alone is larger than all the dry land together.

*Q. Where is the largest whale found?*
A. In the Pacific ocean.

*Q. What is this whale called?*
A. The sperm whale.

*Q. Where is the largest land animal found?*
A. On the largest continent.

## LESSON XXVI.

*Q. Which is the largest continent?*
A. The eastern continent.

*Q. Which is the largest land animal?*
A. The elephant.

*Q. Where is the elephant found?*
A. In Asia and Africa.

*Q. Which is the larger, Asia or Africa?*
A. Asia is much the larger.

*Q. Which produces the larger elephant?*
[illegible] Asia.

[illegible] *continent produces the largest bird?*
[illegible]tern continent.

*Q. What is its name?*

A. The ostrich, which is found in Africa and Arabia.

*Q. Does the western continent produce a bird of similar form and habits?*

A. Yes; the rhea.

*Q. Where is it found?*

A. In South America.

*Q. Is it as large as the ostrich?*

A. No; it is much less.

*Q. Are similar birds found in other countries?*

A. Yes; the emu in Australia, and the cassowary in Borneo.

*Q. How do they differ in size?*

A. In proportion to the relative size of the countries they inhabit.

## LESSON XXVII.

*Q. Where is the largest trout found?*

A. In the largest lake.

*Q. Where are the smallest found?*

A. In the small running streams.

*Q. Are the trout of the same kind in both cases?*

A. They are alike in form, habits and nature.

*Q. Why are the condor and grizzly bear larger than similar animals of the eastern continent?*

A. Because those animals are peculiar to mountainous regions, and America possesses the largest mountain chain in the world.

*Q. Where are the largest quadrupeds found?*

A. On the largest continent.

*Q. Where after the continents?*
A. On the largest islands.

*Q. Where are the smallest ones found?*
A. On the little islands of the Pacific.

*Q. What animals are meant?*
A. Only those that existed there when those countries were first discovered.

*Q. Which was the largest animal found in Australia when it was first discovered?*
A. The kangaroo was the largest.

*Q. Do larger animals thrive there upon being imported?*
A. Yes; all large animals that are natives of similar climates.

## BEASTS OF PREY.

### LESSON XXVIII.

*Q. What is a beast of prey?*
A. An animal that kills another one and feeds upon its flesh.

*Q. To what animals is the term generally applied?*
A. To large, ferocious animals.

*Q. Which are the largest of them?*
A. The lion and tiger of the old world, and the puma and panther of the new.

*Q. Which division of the globe produces the greatest number of beasts of prey?*
A. In number and variety, Africa possesses more than any other division of the globe.

*Q. In what do beasts of prey differ from herbivorous animals?*

A. Chiefly in their size and in the construction of their eyes, teeth and feet.

*Q. Which of the two classes is the larger?*

A. The herbivorous.

*Q. How do their eyes differ?*

A. The eye of the herbivora has a mild and patient look, and is formed for the purpose of viewing objects by day.

*Q. How is the eye of the carnivora formed?*

A. The eye is large, fierce, and luminous in the dark.

*Q. How do their teeth differ?*

A. The carnivora have sharp-pointed teeth to seize and tear their prey, like the teeth of a cat.

## LESSON XXIX.

*Q. What is the form of the teeth of the herbivora?*

A. They have wide front teeth to cut off the herbage, and large molar, or double teeth, at the back of the jaw to grind it, like those of the sheep or ox.

*Q. How do their feet differ?*

A. The herbivora have a solid foot, or hoof, like the horse, or a cloven one, like the ox.

*Q. How are the feet of the carnivora formed?*

A. They are separated into toes, each of which is armed with a strong claw.

*Q. Are the claws movable?*

A. Yes; they will expand and contract at the will of the animal, like the claws of a cat.

*Q. In what position are the claws when in a state of rest?*

A. They are folded up like a knife in a case.

*Q. How is the bottom of the foot formed?*

A. It is soft like velvet.

*Q. Why are the feet so formed?*

A. That they may steal upon their prey unheard.

*Q. Do herbivorous animals make a noise in walking?*

A. Yes; but their food is fixed to the soil.

## LESSON XXX.

*Q. What are the whiskers of a beast of prey?*

A. Hairs standing out from each side of the nose.

*Q. How wide are they?*

A. From tip to tip they measure as much as the widest part of the animal's body.

*Q. Of what service are they?*

A. They serve as feelers to protect the animal from injury.

*Q. In what way?*

A. If the animal can pass its whiskers through the bushes, it can pass its body.

*Q. Why is that provision made?*

A. The beast of prey is slow on foot compared with many of its victims, and must catch them by stealth, by springing from a hiding-place in the bush.

*Q. When are beasts of prey the most ferocious?*

A. When they have been without food for [illegible] time.

*Q. When are herbivorous animals the most docile?*
A. When kept without food.

*Q. How are beasts of prey tamed?*
A. By keeping them well supplied with food.

*Q. How are wild horses and elephants tamed?*
A. By depriving them of food for some days.

## CLASSIFICATION OF ANIMALS.

### LESSON XXXI.

*Q. How are animals divided?*
A. Into four orders.

*Q. What is meant by an order?*
A. All those animals that have some great feature in common.

*Q. What are the names of the four orders?*
A. The vertebra, mollusca, articulata, and radiata.

*Q. What animals belong to the vertebrata?*
A. All those having a backbone.

*Q. What is a backbone?*
A. A column of bones running through the body, to which all the limbs are connected.

*Q. What animals have backbones?*
A. Man, quadrupeds, birds, fishes, and reptiles.

*Q. How is the backbone formed?*
A. Of a number of pieces joined togeth
the joints of a hinge.

*Q. Why is it so formed?*

A. That the animal may adapt its motions to all its wants.

*Q. Why can an eel twist itself into so many shapes?*

A. Because of the large number of joints in its backbone.

*Q. From what is the term vertebra derived?*

A. From the word *verto*, which means to turn.

*Q. Why is the backbone called by that name?*

A. Because each joint turns on the other.

## LESSON XXXII.

*Q. How are the vertebrata divided?*

A. Into two classes.

*Q. What are they called?*

A. The mammalia, or viviparous animals, and oviparous animals, or those producing eggs.

*Q. How are the young of oviparous animals produced from eggs?*

A. Either by incubation, that is by heat obtained from the body of the bird setting on them, or from heat obtained from the sun.

*Q. What animals are oviparous?*

A. All those in the scale of being below quadrupeds, except the bats.

*Q. What are viviparous animals?*

A. Those that produce their young alive, and nourish them with milk.

*Q. Are there any other divisions?*

Yes; classes are again divided in genera.

*Q. What is a genus?*
A. A particular race having one peculiar construction in common.

*Q. To what genus does man belong?*
A. To the bimana.

*Q. What does that word mean?*
A. Having two hands.

*Q. Has any other creature two hands?*
A. No; man forms a genus of himself.

## LESSON XXXIII.

*Q. What are the quadrumana?*
A. Animals having four hands.

*Q. What animals belong to that genus?*
A. All the monkey tribe.

*Q. Does this genus vary in size and appearance?*
A. Yes; the variety is infinite.

*Q. What have they all in common?*
A. Four hands.

*Q. How is a monkey, then, classed in natural history?*

A. It belongs to the vertebrata, is viviparous, and is a quadrumana.

*Q. For what particular action is the quadrumana formed?*

A. For climbing, and springing from tree to tree.

*Q. What is a quadruped?*
A. An animal having four feet.

*Q. Are there many species of them?*
A. Yes, an infinite number.

*Q. Which is the largest quadruped?*
A. The elephant.

*Q. Which is the smallest?*
A. The mouse.

*Q. For what description of motion is the quadruped formed?*
A. For ease and swiftness in running.

## WARM AND COLD-BLOODED ANIMALS.

### LESSON XXXIV.

*Q. What is meant by a warm-blooded animal?*
A. One whose blood is warmer than the average temperature of the atmosphere.

*Q. What is a cold-blooded animal?*
A. One that feels cold to the touch.

*Q. Why does this happen?*
A. Because their blood is colder than ours, and colder than the general temperature of the atmosphere in which they live.

*Q. To which does a fish belong?*
A. To the cold-blooded division.

*Q. What animals have warm blood?*
A. The mammalia and birds.

*Q. What is the temperature of the blood of man?*
A. Ninety-eight degrees by the thermometer.

*Q. What is the temperature of the blood of all the [illegible]?*
[illegible] as that of man.

*Q. Is the temperature of the blood always the same?*

A. Yes; at all seasons of the year.

*Q. Is it the same in all climates?*

A. Yes; from the pole to the equator.

*Q. How is this ever temperature maintained?*

A. By perspiration in summer and by thick clothing in winter.

*Q. How does perspiration act?*

A. It cools the blood by rapid evaporation.

## LESSON XXXV.

*Q. How do animals obtain a thick dress in winter?*

A. As the season advances, the coverings of beasts and birds become thicker and change color.

*Q. Can you name any animals whose dresses undergo those changes?*

A. The birds moult in the spring and have a light and bright dress for summer.

*Q. Can you name any others?*

A. The sheep loses its wool in the same season, but it grows long and thick by winter.

*Q. What animals undergo a change of color in winter?*

A. Many, in cold countries, as the hare and ermine, which change from brown to white.

*Q. Why do they become white in winter?*

A. Because that color allows heat to escape with the least facility.

*Q. Does nature employ any other means to preserve animals from cold?*

A. Yes; they are often enveloped in a thick layer of fat.

Q. *When are animals the fattest?*
A. In winter.

Q. *Where are the fattest animals found?*
A. In the coldest regions.

Q. *Can you name any such?*
A. The whale and polar bear.

Q. *How is the heat of the blood measured?*
A. By means of a thermometer.

Q. *What is that?*
A. An instrument to measure heat.

## LESSON XXXVI.

Q. *By the thermometer, when does water become ice?*
A. When it points to thirty-two degrees.

Q. *What is the temperature of boiling water?*
A. Two hundred and twelve degrees.

Q. *What is the temperature of the blood of cold-blooded animals?*

A. From thirty to forty below that of man.

Q. *What animals have warm blood?*
A. Those that breathe through lungs.

Q. *Which have cold blood?*
A. Those that breathe through gills.

Q. *To what is the heat of the blood attributed?*
A. To the quantity of air consumed.

Q. *Why is the blood of the mammalia all of the same temperature?*

A. Because they all consume the same quantity of air in proportion to the size of their bodies.

Q. *What is the temperature of the blood of birds?*
A. From six to ten degrees above that of man.

*Q. Why is that?*

A. Because they consume more air in proportion.

*Q. Why have fishes and reptiles cold blood?*

A. Because they consume less air than man

## LESSON XXXVII.

*Q In what region of the earth are most of the cold-blooded animals found?*

A. In the tropical regions.

*Q. Are not reptiles found in temperate climes?*

A. Yes; during the summer.

*Q. What becomes of them in winter?*

A. They retire to holes, or bury themselves in the mud.

*Q. Why do they do so?*

A. Because they are unable to endure the cold of winter.

*Q. What effect would the cold have upon them?*

A. Having cold blood, the frost would change the fluids of their bodies into ice, and thus rupture the blood-vessels.

*Q. How do many of our fishes escape the cold of winter?*

A. They leave for warmer climates.

*Q. Do not some remain?*

A. Yes; but they retire to deeper waters.

*Q. Are there any fish found in our waters in winter that leave us in summer?*

A. Yes; but most of them are of a dull color, and have oily skins.

*Q. Whence do they come?*
A. The severity of the northern climate drives them to the south.

*Q. What is the great cause of all those movements?*
A. A constant supply of food, for all animals must eat to live.

## MAMMALIA.

## LESSON XXXVIII.

*Q. What class of animals is placed at the head of all others?*
A. The mammalia.

*Q. Why?*
A. Because of their superior intelligence and usefulness.

*Q. Where are the mammalia found?*
A. On the land, in the waters, and in the air.

*Q. Of what use are the land mammalia to man?*
A. They supply him with food, labor and clothing.

*Q. Which are used for food?*
A. The principal ones in temperate regions are the ox, sheep, hog, deer, hare and rabbit.

*Q. Does the climate influence the taste?*
A. Yes; in parts of Africa and Asia the flesh of the elephant, horse and camel is eaten.

*Q. What animals are consumed by the inhabitants of the arctic regions?*
[illegible] whale, seal, reindeer and dog.

*Q. What use is made of the milk of the mummalia?*

A. From the milk of the cow butter and cheese are made.

*Q. Is the milk of other animals used for that purpose?*

A. Yes; in some countries the milk of the sheep, goat, mare and camel is so used.

*Q. What animals are used for labor?*

A. The larger ones that eat vegetable food.

## LESSON XXXIX.

*Q. What names are given to the flesh of the ox, sheep, deer, and hog?*

A. Beef, mutton, venison and pork.

*Q. How is mutton and venison used?*

A. Always fresh.

*Q. Why is mutton never salted or cured?*

A. The flesh becomes too dry, and the fat too rancid, by salting.

*Q. Why are beef and pork cured?*

A. That they may be preserved for a long time, and thus supply food during long voyages.

*Q. Are all parts of the ox, sheep and hog useful?*

A. Yes; every part.

*Q. Of what use is the hair of the ox*

A. It is mingled with mortar for particular purposes.

*Q. What is made of the skin?*

A. Leather for the soles of shoes.

*Q. What is made of the wool of sheep?*

A. It is made into woolen cloth.

[illegible]

[illegible] make the [illegible] buttons.

## LESSON [illegible]

Q. For what are the bones [illegible] used?

A. To make handles for [illegible] instruments.

Q. What are made from the [illegible] and horns?

A. [illegible] and buttons.

Q. What is made from the [illegible] of the bones?

A. Ammonia, or hartshorn, is distilled from them.

Q. What remains after the distillation?

A. Animal charcoal.

Q. For what purpose is this substance used?

A. To refine sugar.

Q. Why is it used for that purpose?

A. Because it possesses the property of depriving vegetable fluids of all color without otherwise injuring their properties.

Q. Are there any other useful products obtained from the bones and horns?

A. Yes; Prussian blue [illegible] ade from

Q. What is phosphorus?

A. A very inflammable [illegible] bones.

*Q. From what are the strings of musical instruments made?*

A. From the intestines of animals.

*Q. From what is glue obtained?*

A. From the sinews of animals.

## MAMMALIA OF THE SEA.

### LESSON XLI.

*Q. Is the whale a fish?*

A. No; it has but few qualities in common with a fish.

*Q. What are those qualities?*

A. It lives in the water, and has the shape of a fish.

*Q. Why has it the shape of a fish?*

A. Because it is formed for swimming.

*Q. How does it differ from a fish?*

A. It can not remain under water for a long period.

*Q. For what reason?*

A. Because it must come to the surface to breathe air.

*Q. How else does it differ from a fish?*

A. The whale breathes with lungs, is viviparous, and nourishes its young with milk.

*Q. Are there any other similar animals in the water?*

A. Yes; many.

*Q. Where are they found?*

A. In every ocean and sea on the globe.

*Q. What name is given to them?*
A. They are called the cetecea.

*Q. What is the meaning of that word?*
A. A whale, or like a whale.

*Q. Are they all like a whale in size?*
A. No; they differ in that respect as greatly as land animals.

## LESSON XLII.

*Q. Are all whales alike?*
A. No; there are various kinds.

*Q. Which are the most useful to man?*
A. The black whale and the spermaceti whale.

*Q. Where is the black whale found?*
A. In the frozen regions of the north.

*Q. For what is it captured?*
A. For its oil and whalebone.

*Q. From what is the oil obtained?*
A. From the immense layers of fat that envelop its body.

*Q. From what is the whalebone obtained?*
A. From the mouth of the black whale.

*Q. Where is the spermaceti whale taken?*
A. In the Pacific ocean.

*Q. For what is it caught?*
A. For its oil and teeth.

*Q. What part of the whale produces the oil?*
A. The interior of its head.

*Q. Of what use are its teeth?*
A. They furnish a species of ivory.

*Q. Which of the mammalia fly through the air?*
A. The bat is the only one in temperate climates.

## BIRDS.

### LESSON XLIII.

Q. *What is a bird?*

A. An animal formed for rapid flight through the air, and is covered with feathers.

Q. *Do all birds fly?*

A. No; the ostrich, and some water fowl can not fly.

Q. *How do such escape pursuit?*

A. The ostrich by rapid running, and the water fowl by swimming.

Q. *What are water fowl?*

A. Birds that seek their food in the water.

Q. *How do they differ from land birds?*

A. In the form of their feet and beaks, and in the qualities of their feathers.

Q. *For what are their feet formed?*

A. For swimming.

Q. *Which can run the fastest, a chicken or a goose?*

A. A chicken.

Q. *Which sleeps on a roost?*

A. A chicken; water fowl can not roost.

Q. *Why is that?*

A. Because of the formation of their feet.

Q. *How do their beaks differ?*

A. All water fowl have broad, flat beaks.

Q. *How is the beak of a land bird formed?*

A. According to the nature of its food.

## LESSON XLIV.

*Q. How is a chicken's foot formed?*

A. It consists of four separate toes for scratching the earth, to obtain food.

*Q. How is the foot of an eagle formed?*

A. Its toes are armed with talons to seize its prey.

*Q. How is its beak formed?*

A. It is curved, sharp and powerful, to tear its victim to pieces.

*Q. Do the beaks of birds assume many shapes?*

A. There is more diversity among the mouths of birds than among those of any other class of animals.

*Q. Have birds any teeth?*

A. No; they have none.

*Q. How do they consume their food?*

A. They swallow it whole.

*Q. How does the food become bruised?*

A. By means of a gizzard.

*Q. What is a gizzard?*

A. A kind of mill in which the food of a bird is ground up.

*Q. With what is it lined?*

A. A tough substance like leather.

*Q. Why does a bird swallow pebbles?*

A. That they may be deposited in the gizzard and assist in grinding the food.

## LESSON XLV.

Q. *How do the feathers of land birds differ from those of water fowl?*

A. Those of water fowl are covered with oil to prevent water from reaching the skin.

Q. *When does this oil lose its virtue?*

A. When the bird is dead.

Q. *Do the feathers of land birds possess this quality?*

A. No; their feathers absorb water.

Q. *Has a bird warm blood?*

A. Yes; the blood of birds is warmer than that of any other animal.

Q. *What is the temperature of the blood of birds?*

A. That of land birds is one hundred and two, and that of water fowl one hundred and six degrees.

Q. *Is a bird an oviparous animal?*

A. Yes; they all produce eggs.

Q. *How are the eggs hatched?*

A. By the hen sitting on them.

Q. *Are the eggs of all birds hatched in the same period of time?*

A. No; the eggs of small birds are hatched in two weeks.

Q. *In what time are chickens' eggs hatched?*

A. In three weeks.

Q. *A duck's or goose's egg?*

A. In four weeks.

Q. *A guinea fowl's?*

A. In four weeks.

## EGGS OF ANIMALS.

### LESSON XLVI.

Q. *Is an egg a living substance?*

A. It possesses no active life, but contains the germ, or principle of life.

Q. *What is the germ?*

A. The part from which life is developed.

Q. *What is the germ of a vegetable?*

A. The part from which the roots and leaves spring.

Q. *Can you name the germ of any vegetable?*

A. The eye of the potato.

Q. *Has a potato more than one germ?*

A. Yes; every eye is a germ, and capable of producing a perfect plant.

Q. *How is the germ of vegetation developed?*

A. It is aroused to activity by heat and moisture.

Q. *What are the different parts of an egg?*

A. The white, the yolk, and the germ.

Q. *Which is the germ?*

A. A small white spot that floats on the top of the yolk.

Q. *Which is the heaviest part of the egg?*

A. The white part.

Q. *Which is the next heaviest?*

A. The yolk.

Q. *Which is the lightest?*

A. The germ.

## LESSON XLVII.

*Q. What is the shape of the yolk?*
A. Perfectly round.

*Q. Where is the germ found?*
A. The germ, being the lightest part, whichever way the egg is turned, is always on the top of the yolk.

*Q. Why is the egg so arranged?*
A. That the germ may be nearest to the source of heat.

*Q. How are the eggs of birds hatched?*
A. By incubation.

*Q. What is incubation?*
A. The act of sitting on eggs, by the parent bird, to hatch them.

*Q. What animals produce eggs?*
A. All, except the mammalia.

*Q. How are the eggs of reptiles, fishes, and insects hatched?*
A. By the united influence of the sun and air.

*Q. Why do not those creatures sit on their eggs?*
A. Because, having cold blood, they could not impart heat to them.

*Q. At what season of the year are eggs hatched?*
A. In the spring.

*Q. Why is that?*
A. That the young may gain strength before the rigors of winter set in.

## GEOGRAPHICAL DISTRIBUTION OF BIRDS.

### LESSON XLVIII.

*Q. In what regions are birds found?*

A. In every part of the globe.

*Q. Are the same kinds of birds found in every climate?*

A. No; almost every country has some birds peculiar to itself.

*Q. Are there any birds peculiar to America?*

A. Yes; the humming-bird and the condor.

*Q. Where is the condor found?*

A. Among the mountains of South America.

*Q. Where is the humming-bird found?*

A. Throughout North and South America.

*Q. Where have birds the most brilliant plumage?*

A. Within the tropics.

*Q. Do such birds sing?*

A. No; they have mostly discordant voices.

*Q. Where are singing birds mostly found?*

A. In temperate regions.

*Q. What effect has climate upon the beauty of birds?*

A. As we depart from the equator the feathers of birds become less and less brilliant.

*Q. Of what color are they in the frigid zone?*

A. During the summer they are of a light brown, but in winter they become white.

### LESSON XLIX

*Q. Do birds remain in the same region all the year?*

A. Not in temperate climates.

*Q. Why do they move from one country to another?*

A. They come and depart with the change of the seasons, in search of food.

*Q. What birds arrive in this countay in the spring?*
A. Among others, the different species of swallows.

*Q. When do they depart?*
A. As soon as the winter approaches.

*Q. Upon what do swallows feed?*
A. Upon insects only.

*Q. Are insects found here during winter?*
A. No; the first frost drives them away

*Q. Where do the swallows go when they leave us?*
A. They cross the Atlantic for the warm parts of Africa.

*Q. What birds arrive here in winter?*
A. Wild ducks and geese.

*Q. Whence do they come?*
A. From the frozen regions of the north.

*Q. Why do they come?*
A. To enjoy a milder climate and obtain food.

*Q. When do they depart?*
A. In the spring, when they return to the north.

## FOOD OF BIRDS.

### LESSON L.

*Q. Upon what do birds feed?*
A. Upon every organic substance.

*Q. What are rapacious birds?*
A. Those that kill and devour birds and other small animals.

Q. *Can rapacious birds live on vegetable food?*
A. No; they can not digest it.

Q. *Which are rapacious birds?*
A. Among others, eagles, hawks, kites and owls.

Q. *What are carrion birds?*
A. Those that consume the flesh of dead animals.

Q. *Can you name any such?*
A. The condor and vulture.

Q. *Do any birds live entirely on fish?*
A. Yes; many water fowl and wading birds.

Q. *What birds live on insects?*
A. A large number of small ones.

Q. *What beside do many birds eat?*
A. Some live entirely on seed or grain.

Q. *Do any birds live on fruit?*
A. Yes; many.

## LESSON LI.

Q. *Why have some birds such hard and heavy beaks?*
A. That they may be able to break the hard nuts that grow within the tropics.

Q. *What bird lives on honey?*
A. The humming-bird.

Q. *Whence do they obtain the honey?*
A. From flowers, after the fashion of the bee.

Q. *How many toes have birds?*
A. Four, except the ostrich, which has but two.

Q. *How are the toes of birds armed?*
A. According to the nature of their food.

*Q. How are the feet of the eagle armed?*

A. With strong, sharp, curved claws, like those of a cat, that it may seize its prey.

*Q. How is the foot of the chicken formed?*

A. For scratching up the earth in search of food.

*Q. How are the feet of water fowl formed?*

A. Their toes are united together by a web, thus forming a paddle to propel them through the water.

*Q. Do water fowl sleep on a roost?*

A. No; their feet being much behind the center of the body, they can not rest on a roost; they would fall off upon going to sleep.

*Q. Have birds teeth?*

A. No; the gizzard performs the office of teeth, but birds of prey have neither teeth nor gizzards.

## USES OF BIRDS.

### LESSON LII.

*Q. Of what service are birds to man?*

A. Many supply him with their flesh and eggs for food.

*Q. What class of birds are used for this purpose?*

A. Those that live chiefly on vegetable food

*Q. Are rapacious birds ever eaten?*

A. No; their flesh is very repulsive.

*Q. For what purposes are the feathers of birds used?*

A. The smaller ones are chiefly used for beds.

Q. *What uses are made of the larger ones?*

A. For ornament, as the feathers of the ostrich.

Q. *Do birds perform any other useful purpose?*

A. Yes; they scatter the seeds of vegetation.

Q. *How are water fowl useful?*

A. They convey the spawn, or eggs of fish, to newly-made ponds.

Q. *How is that done?*

A. The eggs of the fish adhere to the feathers.

Q. *How do they become detached?*

A. When the birds visit other waters in search of food the eggs are washed off.

Q. *How else are birds useful?*

A. Many consume an immense number of insects and small reptiles, that would otherwise, from their numbers, become injurious.

## REPTILES.

### LESSON LIII.

Q. *What is a reptile?*

A. A cold-blooded, oviparous animal, mostly amphibious; either without feet, or only using them partially as a means of locomotion.

Q. *What is the meaning of amphibious?*

A. Capable of living in the water or on the land.

Q. *Can you name any amphibious animals?*

A. The frog, tortoise, and turtle.

Q. *When does the frog take to the water?*
A. In times of danger.

Q. *Are all reptiles amphibious?*
A. Yes; the construction of their breathing-organs renders them so.

Q. *Where are reptiles mostly found?*
A. In warm and swampy regions.

Q. *Which is the largest reptile?*
A. The crocodile.

Q. *Which is the smallest?*
A. The frog.

Q. *Where is the crocodile found?*
A. In the rivers of Africa.

Q. *Are similar animals found in other parts?*
A. Yes; in the tropical countries of Asia and America.

## LESSON LIV.

Q. *What name are they known by in America?*
A. They are called alligators, and are found in all the rivers of tropical America.

Q. *What name is given to them in Asia?*
A. The crocodile, alligator, and cayman.

Q. *Where is the largest serpent found?*
A. In the swamps of South America.

Q. *By what name is it known?*
A. The boa constrictor.

Q. *For what is it noted?*
A. For its great strength; it can crush an ox in its folds.

Q. *With what are reptiles covered?*
A. With scales.

*[illegible] injurious to man?*

[illegible] armed with a deadly poison.

*[illegible] this power?*

[illegible]

*[illegible] used for food?*

[illegible] of turtles are eaten.

*[illegible] for their flesh?*

[illegible] is used as food [illegible] countries. Also the hind [illegible] eaten by many.

---

[illegible]

## [illegible] LV.

*[illegible] vertebrata?*

[illegible] division.

[illegible] with scales, [illegible] living in the

[illegible] where water is

[illegible] no general

[illegible] in water.

[illegible]

*Q. Have all fish the same shape as the cod?*
A. Yes; all follow the same type, more or less, except the flat fish.

*Q. Can you name any flat fish?*
A. The flounder and halibut.

*Q. Are flat fish formed for rapid swimming?*
A. No; they mostly remain at the bottom of the water.

*Q. Do fish differ from the mammalia in their organs of sense?*
A. Yes; in many particulars.

## LESSON LVI.

*Q. Has the codfish any ears?*
A. No external ones.

*Q. Has it any eyelids?*
A. No; a fish can not shut its eyes.

*Q. Can it move its eyes?*
A. No; its eyes are immovable.

*Q. Has it any nostrils?*
A. No; only rudimentary ones.

*Q. Has a fish any voice?*
A. No; it is perfectly mute under all circumstances.

*Q. Can it move the muscles of its face?*
A. No; it can not express pleasure or anger by its face.

*Q. Why has a fish no external ears?*
A. Water being so much heavier than air, sound is transmitted through it with much greater intensity.

*Q. What effect would that have on fish?*

A. If the fish had ears formed like those of a land animal, it would become stunned with the loudness of sounds.

*Q. Why has a fish no eyelids?*

A. There is no dust in the water.

## LESSON LVII.

*Q. How are the eyes of fish protected?*

A. By a thick, transparent covering.

*Q. Has a fish a tongue?*

A. Yes; but it is immovable.

*Q. Of what color is the flesh of fish?*

A. Mostly white.

*Q. What fish have flesh of a different color?*

A. The salmon and sturgeon.

*Q. Of what color is their flesh?*

A. Red.

*Q. What is the weight of fish?*

A. They are of the same density as water.

*Q. What effect has this on fish?*

A. They can always keep in motion without becoming tired.

*Q. Are all fish externally of the same color?*

A. No; those of cold climates, or those living at the bottom of the water, are of a dark color above, and white beneath.

*Q. Can you name any such?*

A. The cod, eel, and flounder.

*Q. Do such remain with us all the winter?*

A. Yes; they remain all the year.

## LESSON LVIII.

*Q. Can you name any fish that are seen only during he summer?*

A. The mackerel, shad, porgy, and weak-fish.

*Q. Of what colors are they?*

A. Of bright and brilliant colors.

*Q. What becomes of them during the winter?*

A. They depart for a warmer climate.

*Q. When do they return?*

A. In April and May.

*Q. In what region are the colors of fish the brightest?*

A. Within the tropics, where they are scarlet, golden and green.

*Q. With what are fish covered?*

A. With scales.

*Q. Are they all covered with similar scales?*

A. No; some have large, bright scales, and some have small, dull ones.

*Q. What fish have large, bright scales?*

A. The shad, bass, and many others.

*Q. Which have small, dull ones?*

A. The cod and black-fish.

*Q. Which live the longest out of water?*

A. Those with small scales and slimy skins.

## LESSON LIX.

*Q. From what are fish produced?*

A. From the roe, or spawn of the female fish.

*Q. What is the roe like?*

A. A multitude of little eggs bound up in a mass.

Q. *Does each egg become a fish?*
A. Yes; under favorable circumstances.

Q. *How are the eggs hatched?*
A. By the influence of the sun and air.

Q. *Where are the eggs deposited?*
A. In the shallow waters of rivers and bays.

Q. *For what purpose do shad ascend the rivers in the spring?*
A. To deposit their eggs in fresh water.

Q. *Have any other fish similar habits?*
A. Yes; the salmon.

Q. *When the fish have deposited their eggs, what becomes of them?*
A. They descend to the ocean again.

Q. *When do they return?*
A. Not until the following spring.

Q. *Do all fish deposit their eggs in shallow woters?*
A. No; many fish never leave the deep waters, but nature, by many wise contrivances, brings their eggs within the influence of light and heat.

## LESSON LX.

Q. *How many eggs does a fish produce?*
A. A codfish, or shad, will produce above a million of eggs.

Q. *Why do they produce so large a number?*
A. Because the spawn and young fish have to encounter many dangers.

[illegible] *What are some of those dangers?*
[illegible] Many fishes, frogs, and water fowl, live on [illegible] fish.

*Q. How long do the young fish remain in the shallow waters?*

A. Until they gain sufficient strength to descend to the deep waters of the ocean.

*Q. Are the shad and salmon the only fish that spawn in shallow water?*

A. No; the mackerel, herring, and many other fish swarm in immense shoals along the coast during the summer months for the same purpose.

*Q. Are all fish produced in such large numbers as the cod?*

A. No; the large, ferocious fishes, as the shark, are not.

*Q. Why is that?*

A. Because their means of defense are greater.

*Q. What means of defense have fish?*

A. Many have formidable teeth; others sharp spines, and some have a sword, or saw, on the end of the nose.

*Q. Why is the sword-fish so strongly armed?*

A. Because it pursues the whale and other monsters of the deep.

## LESSON LXI.

*Q. Of what use are fish to man?*

A. They supply him with a large portion of food.

*Q. What fish are cured, or preserved for food?*

A. The cod, herring, shad, mackerel, and salmon.

[illegible]

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## [illegible]

### [illegible]

[illegible]

Q. *Are they all covered by a shell?*

A. No; the sepia fish, and many slugs are without a covering.

Q. *What is the sepia?*

A. It is the largest of all the mollusca.

Q. *Where is it found?*

A. In the tropical seas chiefly.

Q. *What are its means of defense?*

A. Upon the approach of danger, it ejects an odorous, dark-colored fluid, which renders the surrounding water noxious and cloudy, and enables the creature to escape the attacks of ravenous fish.

## LESSON LXIII.

Q. *How are the mollusca, in shells, divided?*

A. Into two classes, univalves and bivalves.

Q. *What is a univalve?*

A. An animal living in one shell, as the snail

Q. *What is a bivalve?*

A. An animal living in two shells, as the oyster.

Q. *Have both classes the same freedom of action?*

A. No; the univalve can emerge from its shell and walk about, but the bivalve is nearly incapable of locomotion.

Q. *How else do they differ?*

A. The univalve has a head and eyes, which the bivalve has not.

Q. *How does the bivalve obtain its food?*

A. It can open its shell by means of a powerful muscle.

[illegible] the waters [illegible]

[illegible] rivers and [illegible] near the sea.

[illegible]

[illegible] at the mouths of rivers [illegible]

[illegible] the clam so thick [illegible]

[illegible] is exposed to danger [illegible]

[illegible] above the shell [illegible]

[illegible] soft-shell clams.

[illegible] the action of the

[illegible] in the mud.

[illegible]

[illegible]

[illegible] obtained

[illegible] other

[illegible]

*Q. What is cameo?*

A. It is a raised figure sculptured from a piece of a shell, or from a gem.

*Q. Is a seal a cameo?*

A. No; the figure in a seal is cut into it, and it, therefore, is called an intaglio.

*Q. What shells are used for money?*

A. The small white shell called the cowry.

*Q. Where are they used?*

A. In eastern Africa.

*Q. How are they used?*

A. For small change; a cent is worth fifty.

## ARTICULATA.

### LESSON LXV.

*Q. What animals belong to the articulata?*

A. Lobsters, crabs, shrimps, worms, spiders, and insects.

*Q. What is the meaning of articulata?*

A. Full of joints, or separated into parts.

*Q. How is a worm formed?*

A. Like a number of rings joined together.

*Q. How are spiders formed?*

A. They are separated into two parts, the head and breast forming the front piece.

*Q. How are insects formed?*

A. They seem as though divided into three parts, and have six legs.

Q. [illegible]?

A. [illegible] are inclosed in a hard [illegible].

Q. [illegible]?

A. [illegible]

Q. [illegible]?

A. [illegible] water and on the land.

Q. [illegible]?

A. [illegible]

## LESSON LXVI.

Q. [illegible]?

A. [illegible] formed for flying, [illegible] move-ments.

Q. [illegible]?

A. [illegible] or cut [illegible].

Q. [illegible]?

A. [illegible] various changes many of them [illegible].

Q. [illegible] shape they assume after leaving the egg?

A. That of a caterpillar, or worm.

Q. How does [illegible] in this stage?

A. [illegible] hanging from trees by a silken thread.

Q. What is the next shape they assume?

A. That of a grub.

Q. What is their third shape?

A. That of a moth or butterfly.

*Q. What part does the moth perform?*

A. It produces the eggs from which the caterpillar is hatched.

*Q. Of what use are insects to man?*

A. The bee produces honey, the silk-worm silk. Insects also supply cochineal and shell-lac.

## LESSON LXVII.

*Q. How long is the duration of life among animals?*

A. The time varies greatly according to the species.

*Q. How long does it continue among the mammalia?*

A. About seven times as long as the period from the birth to the full growth of the animal.

*Q. How long is it before the horse arrives at its full growth?*

A. The horse is fully developed when about four years old.

*Q. How long, then, does a horse live?*

A. Very few live to become thirty years old.

*Q. How long is the ox in coming to maturity?*

A. From two to three years.

*Q. What is the term of its life?*

A. From fifteen to twenty years.

*Q. How long does the elephant exist?*

A. From two to three hundred years.

*Q. What are the terms for sheep and swine?*

A. They attain their growth in about two years, and live about fifteen years.

[illegible]

[illegible]

[illegible]

[illegible] period of life a limited [illegible]

## VEGETATION.

## LESSON XXVIII.

[illegible]

[illegible] attached to the [illegible]

[illegible]

[illegible] without a [illegible]

[illegible]

[illegible] from the [illegible]

[illegible] di-[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

*Q. Where do mosses most abound?*
A. In dense forests.

*Q. Why is that?*
A. Because the sun can not penetrate to the soil, which is, therefore, always damp.

◆

## ENDOGENS AND EXOGENS.

### LESSON LXIX.

*Q. What is an endogen?*
A. A plant that increases in growth from within.

*Q. What is an exogen?*
A. A plant that increases in growth from without.

*Q. Can you name any plants that are endogens?*
A. Bamboo, ratan, wheat, and Indian corn.

*Q. Can you name any exogens?*
A. A stick cut from a tree, or a piece of pine, or oak wood.

*Q. What are some of the differences between a bamboo and a stick of pine wood?*
A. The pine stick is solid and covered with bark; the bamboo is hollow, and without bark.

*Q. What other difference is there?*
A. The pine is formed in rings which decrease in size from the circumference to the center; the bamboo is fibrous alike in all its parts.

*Q. How are rings of the exogen formed?*
A. A new ring is formed every year beneath

the bark, and thus the tree becomes enlarged in size.

*Q. How is the endogen enlarged?*
A. The new wood is formed from within, and thus expands the tube in circumference.

*Q. How else do the two classes differ?*
A. In the form of leaf and seed.

## LESSON LXX.

*Q. How is the leaf of the exogen formed?*
A. The leaf is small, with a thick vein running through the center, from which smaller ones start to the sides.

*Q. How is the leaf of the endogen formed?*
A. Long and narrow, with the veins running parallel to the leaf.

*Q. How are the seeds formed?*
A. In one piece, like a cocoa-nut, or the seed of wheat, or Indian corn.

*Q. How are the seeds of the exogen formed?*
A. In two pieces, like a peanut, or a bean.

*Q. Where are the endogens found?*
A. Trees of this class are peculiar to the tropics.

*Q. Can you name any?*
A. All the palm-trees.

*Q. Are any found in the temperate regions?*
A. Those that grow in temperate climes are annuals.

*Q. Can you name any?*
A. Indian corn, wheat, rye, oats, rice and barley

*Q. Do the products of the two classes differ?*
A. The endogens supply food and clothing, as bread and cotton.

*Q. What do the exogens supply?*
A. Timber, fruits, gums and medicines.

## LESSON LXXI.

*Q. Why can not endogens continue during winter?*
A. Being full of sap, and without bark, the first frost destroys them.

*Q. How are they produced in cold climates?*
A. By sowing fresh seed every year.

*Q. Do exogens grow in warm climates?*
A. Yes; many grow to an immense size.

*Q. How does the wood differ from the wood of those growing in cold climates?*
A. In hardness and color.

*Q. Of what colors are the different woods?*
A. Dark and rich colors, as mahogany, rosewood, fustic, logwood, and ebony.

# LEAVES.

## LESSON LXXII.

*Q. Are all trees covered with leaves?*
A. Yes; during the summer.

*Q. Of what use are the leaves to a tree?*
A. They are the lungs of the tree, and expose the sap to the action of the atmosphere.

*Q. What effect has the atmosphere upon the sap?*

A. It prepares it to form the flowers, fruit, and the wood of the tree.

*Q. Are both sides of a leaf alike?*

A. No; one side is smooth and polished, the other is rough and downy.

*Q. Which side is turned upward?*

A. The polished side.

*Q. Why is that?*

A. To throw off the rain; if water should lodge in the leaves it would rot them.

*Q. How is the under side of a leaf formed?*

A. It is rough, full of small pores, and covered with minute hairs.

*Q. Why is it so formed?*

A. That it may exhale and inhale oxygen and carbon.

*Q. At what season are the trees covered with leaves?*

A. Most trees are covered with leaves during the summer only, but some are evergreens.

*Q. When do the leaves fall off?*

A. When the sap ceases to flow through the tree.

## LESSON LXXIII.

*Q. Do trees increase in size after the leaves fall off?*

A. No; they cease to grow when the sap ceases to flow.

*Q. Are all leaves alike?*

A. No; every tree has a leaf peculiar to itself.

*Q. What are evergreens?*

A. Trees that are always in leaf.

*Q. With what are such leaves filled?*
A. With turpentine, or a strong, fragrant oil.

*Q. What effect has this on the leaf?*
A. It prevents the sap from freezing.

*Q. Where are the trees always in leaf?*
A. Within the tropics, where the old leaves remain until pushed off by new ones.

*Q. Are the leaves of all trees placed horizontally?*
A. No; the leaves of most trees in Australia are placed edgewise to the earth.

*Q. What effect has this arrangement?*
A. Trees there give but little shade.

*Q. Is there any other difference?*
A. Both sides of the leaf are rough and dull alike.

## LESSON LXXIV.

*Q. In what are the leaves of trees inclosed before they expand?*
A. In a bud.

*Q. With what is the bud covered?*
A. The bud is inclosed with scales to protect the young leaves from the cold.

*Q. With what are the scales covered?*
A. With a resinous, or gummy substance, to exclude all moisture.

*Q. What is the action of the scales?*
A. With increasing warmth the gum softens and the scales expand, but if cold weather ensues, they contract and protect the bud.

*Q. What become of the scales?*
A. When the leaves expand the scales fall off, being of no further use.

*Q. To what uses are leaves applied?*
A. Many; tea is the leaf of a plant growing in China.

*Q. What is senna?*
A. The leaf of a plant growing in Egypt.

*Q. What is hay?*
A. The dried leaves of the herbage of temperate climes.

*Q. Upon what do herbivorous animals feed?*
A. Upon the foliage of the earth.

## LESSON LXXV.

*Q. Do all herbivorous animals consume the same kind of herbage?*
A. No; what is fondly eaten by one is rejected by others.

*Q. Why are they rejected?*
A. Because, if taken, they would be poisonous.

*Q. How do we know that?*
A. The goat can thrive upon many plants that would poison a cow.

*Q. Do all plants grow in the same situations?*
A. No; some are peculiar to the sea-shore, some to swamps; others only exist under the influence of the sun, while others will only h in the shade.

*Q. What is the result of this?*

A. The whole of the land is covered with vegetation.

*Q. What would be the consequence if all animals consumed the same kind of herbage?*

A. Many plants would be totally destroyed.

*Q. What kind of plants thrive on the sea-shore?*

A. Coarse, hardy, thrifty ones, that have long, fibrous roots.

*Q. Why are they placed there?*

A. To hold together the sand and render it solid, so that it may not be scattered over more fertile lands by the winds.

*Q. Do those plants improve the sand?*

A. Yes; the leaves fall off and decay, and thus prepare the soil for richer plants, which in time grow up and exterminate the first occupants.

## ROOTS.

### LESSON LXXVI.

*Q. What is a root?*

A. A thready fabric running through the soil in every direction to seek food for the plant.

*Q. Is the woody part of the tree that is under ground the true root?*

A. No; that part merely serves to keep the tree in its position, and fix it to the soil.

*Q. What are the true roots of a plant?*

A. The thousand little fibers that start in every direction into the soil.

*Q. What are the roots of the onion or turnip?*

A. The little filaments that are attached to the bottom of the one and the sides of the other.

*Q. What part do the roots perform?*

A. They absorb inorganic matter when dissolved by the rain, and convert it into vegetable tissue.

*Q. Do all roots absorb the same materials in the same proportion?*

A. No; if they did, there would be but one kind of vegetation.

*Q. Does this cause the diversity in vegetation?*

A. Yes; the roots of no two plants absorb exactly the same materials.

*Q. Can you name an instance of this?*

A. The roots of the Indian corn absorb silica to supply the stalk and seed with a hard, polished covering, but the root of the potato rejects it, because none is required.

*Q. Why can not the same plants be always raised on the same land?*

A. Because the soil becomes exhausted of the materials necessary to its growth, while others abound to excess.

## LESSON LXXVII.

*Q. Do roots, so called, vary in their properties and appearance?*

A. Yes; some are woody, others mealy, or farinaceous, some fleshy, and some are bulbous.

*Q. Can you name one that is mealy?*

[illegible]es; the potato.

*Q. Can you name some that are fleshy?*
A. The beet and carrot.

*Q. Which is the most nutritious?*
A. The potato.

*Q. Why?*
A. Because it contains the most flour, or starch.

*Q. Upon what does the value of an eatable root depend?*
A. Upon the quantity of flour it contains.

*Q. What are the next in value?*
A. Those that contain the most sugar.

*Q. Which contains much sugar?*
A. The beet.

*Q. Can you name any others?*
A. The carrot, turnip, parsnip, radish, and celery.

*Q. To what do those roots owe their agreeable flavor?*
A. To the minute intermixture of sugar with the juices of the root.

*Q. Are all those roots eaten in the same state?*
A. No; the potato, beet, carrot, and turnip, require cooking before they are eaten; the radish and celery are eaten raw.

*Q. Why are the first-named roots cooked before they are eaten?*
A. Because they contain starch, which requires cooking to develop its nutriment.

## LESSON LXXVIII.

*Q. What is starch?*

A. The nutritious principle of vegetable food.

*Q. Does starch always require cooking?*

A. Yes; its most valuable qualities are developed by heat.

*Q. Can you give an instance?*

A. Raw flour is disagreeable to the taste, and will not satisfy hunger, but when made into bread, it is pleasant to the taste and a satisfying food.

*Q. Are roots much cultivated?*

A. Yes; in most countries large quantities of potatoes, and other roots, are raised for the use of man and cattle.

*Q. Are roots ever boiled for cattle?*

A. Yes; when they are being fatted, or when great care is required.

*Q. Does the cooking of roots add to their qualities of nutriment?*

A. Yes; very much so.

*Q. Why is that?*

A. Because the elements of food are but few, and heat develops them to their greatest extent.

*Q. What are the elements of food, or nutrition?*

A. In vegetables, starch, gum and sugar, mixed with gluten.

*Q. What causes the great diversity of flavors in vegetable food?*

A. Those different substances being mixed in various proportions, or the presence of a little acid, or aromatic oil.

*Q. What are bulbous roots?*
A. Those that are formed in layers, or scales, like an onion or lily.

*Q. For what are they cultivated?*
A. The onion and leek are used for food; most others are cultivated for their flowers.

*Q. Which are cultivated for flowers?*
A. The tulip, crocus, lily and hyacinth.

## SAP.

### LESSON LXXIX.

*Q. What is sap?*
A. The juice of plants which is absorbed from the soil by their roots.

*Q. What office does it perform for the plant?*
A. The same part as the blood performs for an animal.

*Q. What is that?*
A. Every part of the plant, root, stem, flower and fruit, is formed from the sap.

*Q. Do all plants require to be placed in the ground in order to grow?*
A. Yes; but some roots will commence to grow before they are planted.

*Q. Can you name any?*
A. The onion and potato.

*Q. Why do they begin to grow?*
A. The increasing warmth of spring starts the

80739B

germ of life into activity, because the roots contain water.

*Q. Will they continue to grow?*
A. No; the stock of food for the plant soon becomes exhausted.

*Q. What effect has this growth upon the root?*
A. The root withers up and becomes useless.

*Q. Will seeds grow in this manner?*
A. No; seeds contain no water.

## LESSON LXXX.

*Q. What part of the root, or seed first starts into activity?*
A. The germ, or radicle.

*Q. Which part is that?*
A. In the potato it is the eye; in the bean it is a little shoot between the two lobes.

*Q. How does the radicle begin to grow?*
A. The stem of the plant ascends to the light, but the root strikes into the earth.

*Q. Do both spring from the same part?*
A. Yes; every part of the plant grows from the radicle.

*Q. What are the first necessities for the growth of plants?*
A. Water, light, air, and heat.

*Q. Why is water absolutely necessary?*
A. Because it is capable of dissolving every substance required by the plants.

*Q. What are they?*

A. The water itself is composed of the chief elements of a plant, oxygen and hydrogen.

*Q. Is water decomposed by ascending through the root and stem of the tree?*

A. Yes; it is changed into those two gases.

*Q. What shape does the hydrogen assume?*

A. It assimilates with the wood and becomes a portion of it.

*Q. What becomes of the oxygen?*

A. It is exhaled by the leaves, and thus supplies the waste caused by animal life and combustion.

*Q. What does the water dissolve in its passage through the soil?*

A. All that is necessary for the growth of the plant.

## THE CEREALIA.

### LESSON LXXXI.

*Q. What are the cerealia?*

A. The bread-corn bearing plants.

*Q. Why are they called cerealia?*

A. From Ceres, the heathen goddess of tillage.

*Q. What plants belong to this order?*

A. Wheat, barley, oats, rye, rice, Indian corn, millet, and a few others.

*Q. How do they grow?*

A. They are grasses, that is, they grow like grass.

*Q. How do grasses grow?*
A. They grow from the ground in narrow leaves like ribbons.

*Q. Which part of the plant is the most useful?*
A. The seed.

*Q. Why?*
A. Because it supplies man and cattle with much food.

*Q. Where is wheat chiefly grown?*
A. In countries within the temperate zone.

*Q. Why is that?*
A. Because in hot countries it grows too fast, and runs to straw and leaves, and in cold ones it will not ripen.

## LESSON LXXXII.

*Q. What supplies the place of wheat in cold countries?*
A. Barley and oats.

*Q. What supplies its place in hot climates?*
A. Indian corn, rice and millet.

*Q. When those seeds are ground, what are they called?*
A. Flour or meal.

*Q. To what is the name of flour given?*
A. Chiefly to ground wheat and rice.

*Q. What name is given to the others when reduced to powder?*
A. Meal; as barleymeal, oatmeal, and Indian

*Q. When America was discovered, were wheat, barley and oats found there?*

A. No; the country produced no bread-corn except Indian corn.

*Q. Who first introduced wheat and barley into America?*

A. The Spaniards, when they settled in Mexico.

*Q. When the southern hemisphere was discovered, did it possess any corn-bearing plants?*

A. No; it did not contain one.

*Q. Upon what did the people found there live?*

A. Upon fish and other marine products found upon the shore, and upon the flesh of the few small animals obtained by hunting.

## LESSON LXXXIII.

*Q. Were the natives of those countries civilized?*

A. No; they were in an extremely barbarous state.

*Q. Why was that?*

A. They did not possess the means of becoming civilized.

*Q. Why so?*

A. They could only exist in small numbers, and those were scattered over the land in constant search for food.

*Q. What portion of America was thickly peopled when discovered by the Spaniards?*

A. The West India Islands and Mexico.

*Q. Why was that?*

A. Because those countries produced many fruits and roots that were very nutritious.

*Q. Did the natives of those countries cultivate the land?*

A. Yes; they grew Indian corn, bananas, and some roots.

*Q. Why did not the people of Australia cultivate the land?*

A. Because they had nothing that they could use as food to cultivate.

*Q. Upon what does the welfare, and civilization of a nation depend?*

A. Upon a constant and plentiful supply of food.

# METALS.

## LESSON LXXXIV.

*Q. What is a metal?*

A. A simple substance that can be melted in the fire without changing its nature.

*Q. Can you name any metals?*

A. Gold, silver, copper, iron, lead, and zinc are the most common.

*Q. Are there other metals than these?*

A. Yes; there are some forty others, but some are very rare, and others of no practical use.

*Q. Can all metals be melted by heat?*

A. Yes; but some require a greater degree of heat than others to melt them.

*Q. From what are metals obtained?*

Mostly from ores.

*Q. What is an ore?*
A. A metal mixed with many impurities.

*Q. Are any of the metals found pure?*
A. Gold, silver, and platina, are sometimes found pure.

*Q. Is iron ever found pure?*
A. No, not quite; meteoric iron is the nearest approach to pure iron.

*Q. What metals are called precious metals?*
A. Gold and silver.

*Q. Why?*
A. Because of their value, beauty, and indestructible qualities.

## LESSON LXXXV.

*Q. What is one of their chief qualities?*
A. They will not corrode, or decay by exposure to water and air.

*Q. Will iron corrode?*
A. Yes; it will become rusty and decay away.

*Q. Why are gold and silver coined into money?*
A. Because of their durability, beauty, and value.

*Q. Why are gold and silver so valuable?*
A. Because of their rarity.

*Q. Which is the more valuable?*
A. One ounce of gold is worth fifteen ounces of silver.

*Q. Where is gold found?*
A. In mountainous countries, in the [illegible] regions of the earth.

*Q. Where is silver found?*

A. Mostly in elevated regions within the tropics.

*Q. Is money made of pure gold and silver?*

A. No; a small portion of copper is always mixed with them.

*Q. For what purpose?*

A. Pure gold and silver are soft metals, and money made from them alone would soon become defaced.

*Q. What effect has the copper?*

A. It hardens them.

## LESSON LXXXVI.

*Q. Which is the most useful metal?*

A. Iron.

*Q. Which is the most abundant?*

A. Iron.

*Q. Where is iron found?*

A. In every part of the earth.

*Q. How many descriptions of iron are there in use?*

A. Three; wrought iron, cast iron, and steel.

*Q. How do they differ in quality?*

A. Wrought iron is tough and malleable, cast iron is hard and brittle.

*Q. When is a metal said to be malleable?*

A. When it can be made thinner by rolling, or put into shape by hammering.

*ast iron malleable?*

; cast iron is broken into fragments by

g.

*Q. Are all metals malleable?*
A. Nearly all, in a greater or less degree.

*Q. Which is the most malleable?*
A. Gold.

*Q. What advantage is taken of that quality?*
A. It is beaten into extremely thin leaves for gilding.

## LESSON LXXXVII.

*Q. When iron is first extracted from its ore, of what kind is it?*
A. Cast iron.

*Q. How is wrought iron obtained?*
A. By rolling, and working cast iron at a very high temperature.

*Q. What effect has this process?*
A. It renders the iron more pure.

*Q. What new properties are imparted to the iron so treated?*
A. It becomes tough, its structure is altered, and it will weld.

*Q. What is meant by structure?*
A. If a piece of cast iron be broken, its fracture is clean and crystalline, but the fracture of wrought iron is ragged or fibrous.

*Q. What is meant by welding?*
A. If two, or more pieces of iron be raised to a white heat, and then rolled, or hammered together, they become one solid piece.

*Q. Do any other metals possess this quality?*
A. Yes; platina, cobalt, and nickel.

*Q. Does this quality add to the value of those metals?*

A. Yes; without it iron would lose half its value, and platinum would be nearly useless.

*Q. How would iron be debased in value?*

A. Large pieces of wrought iron, as anchors, and shafts for steamships, can only be made by welding many pieces together.

*Q. Does wrought iron lose the quality of welding upon being melted?*

A. Yes; it then becomes cast iron again.

## LESSON LXXXVIII.

*Q. Why would platinum be useless without this property of welding?*

A. It is obtained only in small grains, which will not melt in the hottest fire.

*Q. How is it obtained in sheets?*

A. By the grains being raised to a white heat, and then welded together by rollers.

*Q. For what purpose is platina used?*

A. Retorts for the manufacture of sulphuric acid, and other chemical apparatus, are made from it.

*Q. Why is it used for that purpose?*

A. Because the fire will not melt it, nor will any simple acid affect it in the least degree.

*Q. Are nickel and cobalt ever welded?*

A. No; they are only used to form alloys with other metals.

[illegible] *What is steel?*

[illegible] Steel is made from the best wrought iron bars.

Q. *How is it made?*

A. The bars of iron are imbedded in lighted charcoal, where they remain for many hours.

Q. *How does steel differ from iron?*

A. It possesses many qualities that wrought iron does not.

Q. *What are some of them?*

A. Steel is very elastic, very hard, and can be made into a permanent magnet.

Q. *What advantage is taken of its elasticity?*

A. It is made into springs of all descriptions.

Q. *What advantage is taken of its hardness?*

A. All cutting instruments are made from it.

## LESSON LXXXIX.

Q. *What is a magnet?*

A. A piece of steel that will attract other pieces of steel or iron.

Q. *Can iron be rendered magnetic?*

A. Iron is magnetic while connected to a magnet, but loses that quality upon being separated.

Q. *What other quality does a magnet possess?*

A. Upon being placed upon a pivot it always points north and south.

Q. *For what is the magnet used?*

A. To point out the course of a ship in crossing the ocean.

Q. *Can a magnet be made of any other metal?*

A. Yes; from all those that will weld.

Q. *Are any of them used for that purpose?*

A. No; only steel is so used.

*Q. Are all metals of the same weight and density?*
A. No; they all differ.

*Q. Which is the lightest?*
A. Iron.

*Q. Which is the heaviest?*
A. Platinum, and gold is the next.

*Q. What is the weight of iron?*
A. Seven times heavier than water.

*Q. What is the weight of platina and gold?*
A. Platinum is twenty times, and gold nineteen times heavier than water.

## LESSON XC.

*Q. Which is the best conductor of heat?*
A. The heavier metal.

*Q. Which becomes the hotter in the sun, wood or iron?*
A. Iron.

*Q. Which becomes the colder in the winter?*
A. Iron.

*Q. Which will boil water first, an iron kettle or one made of copper?*
A. The one that is made of copper.

*Q. Why?*
A. Because copper is the denser metal.

*Q. Which wears out first?*
A. The iron one.

*Q. Why is that?*
A. Because fire and water corrode iron much faster than they do copper.

*Why are not all kettles made of copper?*
Because copper is much dearer than iron.

*Q. Why are the joints of a rule made of two different metals, brass and iron?*

A. If they were both made of the same metal they would soon wear out, and the joints become useless.

## LESSON XCI.

*Q. Why is that?*

A. Because the friction of two pieces of the same metal is much greater than that of two pieces of different metals.

*Q. Is this fact taken advantage of in other machinery?*

A. Yes; in a locomotive engine.

*Q. In what parts?*

A. Where the friction is the greatest.

*Q. Of what colors are the metals?*

A. Most of them are of a whitish gray.

*Q. What metals are of a different color?*

A. Gold and copper.

*Q. Are bronze and brass white?*

A. No; but bronze and brass are not pure metals; they are alloys.

*Q. What is an alloy?*

A. Two or more metals melted together in certain proportions.

*Q. Why are alloys made?*

A. Because for many purposes they are more valuable than pure metals.

*Q. How does brass differ from copper?*

A. It is easier to fuse, better to cast molds, harder, and possesses more beauty

*Q. Will all alloys melt at a lower temperature than pure metals?*

A. Yes; solder will melt at less than a red heat.

## LESSON XCII.

*Q. Is solder an alloy?*

A. Yes; it is formed of lead and tin.

*Q. Will either lead or tin melt below a red heat?*

A. No; they require a stronger heat than that.

*Q. Of what is brass composed?*

A. It is a mixture of copper and zinc.

*Q. Why is it used for candlesticks and other articles of furniture?*

A. Brass being the harder metal, makes a sharper and more perfect casting than copper.

*Q. Is there any other reason?*

A. Brass is the more beautiful metal, nor will it tarnish so quickly as copper.

*Q. Why are the tubes in locomotive steam boilers made of brass?*

A. Because those made of copper or iron are quickly destroyed by the fire.

*Q. What is bronze?*

A. A mixture of copper and zinc.

*Q. For what is it used?*

A. For the making of statues, bells, guns and various other articles.

*Q. What names are given to this alloy?*

A. Bronze, bell metal and gun metal.

*Q. Are all three alloys made of the same materials?*

Yes, but in different proportions.

## LESSON XCIII.

*Q. For what is bronze used?*
A. For statues and ornaments.

*Q. Why is it used for that purpose?*
A. For its beauty, hardness, and indestructibility by the elements.

*Q. Why are cannon made of this alloy?*
A. Because of its toughness, and its power of resisting the action of gunpowder when discharged.

*Q. Why are bells made of it?*
A. Because it is a very sonorous metal.

*Q. Are all metals sonorous?*
A. Most of them are, but all pure metals are less sonorous than alloys.

*Q. Why are musical instruments made of brass?*
A. Because brass is very sonorous.

*Q. Are metals used in any other than their solid state?*
A. Yes; some of them are dissolved in acids; they are then called oxyds.

*Q. What does that mean?*
A. Something dissolved in, or mixed with an acid.

*Q. What is the rust of iron?*
A. An oxyd of iron.

*Q. What causes the iron to rust?*
A. The oxygen, or acid in the atmosphere and water.

## LESSON XCIV.

*Q. What names are given to those oxyds?*
A. They are named after the acids in which they are dissolved.

*Q. What is acetate of copper?*
A. Copper dissolved in acetic acid, or vinegar.

*Q. What is nitrate of copper?*
A. Copper dissolved in nitric acid.

*Q. What is sulphate of copper?*
A. Copper dissolved in sulphuric acid.

*Q. For what are the oxyds of metals used?*
A. For painting, dyeing, and medicine.

*Q. What metal is chiefly used for painting?*
A. Lead, which is reduced to an oxyd by vinegar.

*Q. What name is given to it?*
A. White lead.

*Q. How is it prepared?*
A. The oxyd is ground in linseed oil.

*Q. What is red lead?*
A. Lead reduced to an oxyd by means of heat.

*Q. Are any other oxyds used for painting?*
A. Yes; many are so used for painting glass and china.

## LESSON XCV.

*Q. Why are the oxyds of metals used for that purpose?*

A. Because the colors in glass and china must be burned in, and none but mineral colors will stand the fire.

*Q. How are metals used for dyeing?*

A. They are dissolved in acids and used as mordants.

*Q. What metals are chiefly used for that purpose?*

A. Iron and tin.

*Q. What is copperas?*

A. Sulphate of iron used for dyeing and making ink.

*Q. What metals are used for medicines?*

A. Mercury is the one chiefly used.

*Q. Are the oxyds of metals poisonous?*

A. Some preparations from metals are extremely poisonous.

*Q. For what purposes is the nitrate of silver used?*

A. To make lunar caustic, fulminating powder, and for plating the surface of other metals.

*Q. What color are the solutions of copper?*

A. They are all green.

*Q. Of iron?*

A. Brown.

*Q. Of lead?*

A. White.

*Q. Those of gold?*

A. A deep red.

*Q. What are obtained from those solutions?*

A. The various colors used as mineral pigments

## MONEY.

### LESSON XCVI.

*Q. What metals are coined into money?*
A. Gold, silver, and copper.

*Q. What is coined money?*
A. A piece of metal of a given weight and fineness, bearing upon it the value of the coin and the escutcheon of the country by which it is issued.

*Q. What is a bank bill?*
A. A printed paper, representing a certain amount of coined money due to the holder of the bill by the bank.

*Q. Why are metals coined into money?*
A. Because of their beauty, value and durability.

*Q. By whom was money first coined?*
A. By a people in Greece about seven hundred years before the birth of Christ.

*Q. Of what was the first money coined?*
A. Of silver, copper and bronze.

*Q. What was the standard of value previous to that?*
A. Silver and copper by weight.

*Q. When, and by whom, was gold first coined?*
A. By Darius, king of Persia, 530 B.C.

*Q. When was silver first coined in Rome?*
A. 266 years B.C.

*n did the Romans first coin gold?*
y-two years later.

## LESSON XCVII.

*Q. What is the standard of value in the United States?*

A. The dollar, in silver.

*Q. Have all nations the same standard?*

A. No; almost every nation has its own standard of value.

*Q. How do the English keep their accounts?*

A. In pounds sterling, one of which is worth nearly five dollars.

*Q. What standard coin is used by the French?*

A. The franc, worth about eighteen cents.

*Q. Which is the most universal coin?*

A. The Spanish dollar, which is current in most parts of the world.

*Q. From what country is the word dollar derived?*

A. From Germany, where it was first used as the name of a coin.

*Q. How was it introduced into Spain?*

A. By Charles V., Emperor of Germany and King of Spain.

*Q. Was Charles a Spaniard?*

A. He was born in Belgium; his father was a German, but his mother was a Spanish woman.

*Q. How did the dollar come into such universal use?*

A. Because the silver of Peru and Mexico was first coined by the Spaniards during the r
Charles V.

*Q. Is gold coined into money in Asia?*
A. No; silver is the coin chiefly used.

*Q. Of what is the coined money of China made?*
A. Of copper; silver is exchanged by weight, and gold in thin leaves of a certain size.

## GEMS.

### LESSON XCVIII.

*Q. What are gems?*
A. Small stones of great beauty and value.

*Q. Why are they so dear?*
A. Because they are very scarce.

*Q. Where are they found?*
A. The finest are found within the tropics.

*Q. What form do they assume?*
A. They are all crystals.

*Q. What is a crystal?*
A. A bright substance always of a definite shape.

*Q. What is meant by a definite shape?*
A. Having always an exact number of sides.

*Q. Is salt a crystal?*
A. Yes.

*Q. Is sugar?*
A. Yes.

*Q. What are ice, snow and hail?*
A. Crystals of water.

*Q. Can you name any gems?*
A. The diamond, emerald, ruby, topaz, amethy[illegible]rnet, sapphire and pearl.

## LESSON XCIX.

Q. *Have all diamonds the same number of sides?*
A. Yes; or they would not be diamonds.

Q. *Why is that?*
A. Because every particular crystal, to possess qualities in common, must assume one common shape, as much as two animals of exactly the same habits.

Q. *What number of sides has a diamond?*
A. Eight.

Q. *What are its peculiar qualities?*
A. Extreme hardness and brilliancy.

Q. *What is its degree of hardness?*
A. It is the hardest of all known substances

Q. *Where are diamonds found?*
A. In the East Indies and Brazil.

Q. *Of what weight are the largest known?*
A. The Star of the South weighs one hundred and twenty-five carats, and the Koh-i-noor, or mountain of light, weighs one hundred and sixteen, or nearly an ounce.

Q. *What is a carat?*
A. A weight of four grains.

Q. *Are diamonds cut and polished by art?*
A. Yes; when found they are either black outside, or like dull pieces of glass.

Q. *How are diamonds cut and polished?*
A. They are first rubbed against each other by machinery.

## LESSON C.

*Q. Why are they subjected to this operation?*

A. Being of such intense hardness, nothing but a diamond will cut a diamond.

*Q. What is done with the dust thus rubbed off?*

A. It is used to polish the diamond.

*Q. What is the value of this dust?*

A. Three hundred dollars an ounce.

*Q. How are diamonds polished?*

A. Upon plates of metal, which are made to revolve with great rapidity.

*Q. How fast do the plates revolve?*

A. From one to three thousand revolutions a minute.

*Q. How long does it take to cut and polish a large diamond?*

A. The "Koh-i-noor" was recut and polished in thirty-eight days, working twelve hours a day, with a steam engine of six-horse power.

*Q. Was this considered as a long period?*

A. No; the "Regent," the largest diamond of France, took two years to polish it, without steam power.

*Q. Why does it take so long?*

A. Because of the extreme hardness of the diamond.

*Q. How is the price of diamonds calculated?*

A. A diamond that weighs a carat is valued at fifty dollars.

## LESSON CI.

Q. *In what ratio does the price increase?*
A. With the square of the weight.

Q. *How is that?*
A. Should one weigh two carats and another three, the square of two being four, and the square of three being nine, one would be worth four times fifty and the other nine, times fifty dollars.

Q. *For what is the diamond used besides for ornament?*
A. For cutting glass.

Q *Of what is the diamond composed?*
A Of pure carbon.

Q. *Of what color is the emerald?*
A. Of a bright green.

Q. *How many sides has it?*
A. Six.

Q. *What is the color of the ruby?*
A. Deep red.

Q. *Of the amethyst?*
A. Violet.

Q. *Of the topaz?*
A. Yellow.

Q. *Of the sapphire?*
A. A bright blue.

## LESSON CII.

Q. *What is a pearl?*
A. A stone found in a species of oyster.

Q. *Where are those oysters found?*
A. In the Persian Gulf, and around Ce

*Q. How are they obtained?*

A. By divers descending to the bottom of the water.

*Q. What are done with the oysters?*

A. They are placed in the sun to decay, the remains are washed and the pearls collected.

*Q. What shape are they?*

A. Either round or oblong.

*Q. What appearance have they?*

A. A silvery, translucent white.

*Q. How large are they?*

A. The largest are the size of a bean.

## GLASS.

## LESSON CIII.

*Q. What is glass?*

A. A bright, brittle, transparent substance, used for windows, drinking-vessels, and for various other domestic purposes.

*Q. How was the making of glass discovered?*

A. It is said to have been by accident.

*Q. By what means?*

A. By some sailors making a fire on the seashore; they used dry sea-weed for fuel, and the ashes mingling with the sand, a rough glass was the result.

*Q. Was this long ago?*

Yes; between two and three thousand

*Q. How many descriptions of glass are there?*
A. Four; flint glass, crown or window glass, plate glass and bottle glass.

*Q. For what is flint glass used?*
A. For the making of tumblers, decanters, etc.

*Q. Of what is it made?*
A. Of fine sand, soda, and red lead, melted together in a furnace.

*Q. Of what use is the lead?*
A. It gives the glass more toughness, briliancy and weight.

*Q. What is the basis of all glass?*
A. Fine sand, or silica, and soda.

## LESSON CIV.

*Q. What is plate glass?*
A. The materials are very carefully prepared and melted together, and then cast upon a table of hot copper.

*Q. What is done to it after that?*
A. It is rendered perfectly smooth while in a state of semi fusion, and when cool enough to be removed, it is annealed.

*Q. What is annealing?*
A. Placing a thing in an oven and letting it gradually cool for several days.

*Q. What effect has that?*
A. Glass after being melted, if allowed to become suddenly cool, would be very brittle, and break with the sudden changes of the weather.

[illegible] the

[illegible] and

[illegible] used for

[illegible] was only

[illegible] years ago none

[illegible] from the roughest materials, as sea sand, wood ashes, and a portion of clay.

*Q. Why is glass so good a material to make bottles of?*

A. Because acids or liquids will never eat it away.

*Q. Did the ancients make bottles of glass?*

A. No; they made them of leather and untanned skins.

*Q. What are spectacles?*

A. They are two glasses, or lenses placed in a frame to assist imperfect vision.

*Q. Who are those that wear spectacles?*

A. Short-sighted people and old people.

*Q. Why do old people wear them?*

A. Because the pupil of the eye becomes flat with age, and the lens bends the rays of light to suit the defect.

*Q. Why do short-sighted people wear them?*

A. There the pupil is too round, and they can not see objects distinctly without a lens.

*Q. What else are lenses used for?*

A. For telescopes.

## COLORS.

### LESSON CVI.

*Q. What are colors?*

A. Different hues with which materials are stained.

*Q. From what are they derived?*

A. From the three divisions of nature, animal vegetable and mineral.

*Q. What are primary colors?*

A. The principal ones, from a mixture of which all others are derived.

*Q. Which are the primary colors?*

A. Red, yellow and blue.

*Q. Are all other colors derived from these three?*

A. Yes; by various modifications and mixtures of them.

*Q. How is a green produced?*

A. From yellow and blue.

*Q. How is brown produced?*

A. From a mixture of red and yellow.

*Q. How is black produced?*

A. By mingling the three primary colors.

*Q. What colors are obtained from animal substances?*

A. Red, blue and brown.

*Q. What animals supply a red coloring?*

A. Cochineal, kermes, shell-lac, and sepia.

*Q. Of what description of animals are these colors derived?*

A. They are all of insect production except sepia, which is obtained from a marine animal.

## LESSON CVII.

*Q. What are kermes?*

A. The word means little worms, and is a small insect found in Asia and southern Europe, which, when dried, is used as a red dye for wool.

*Q. What is the nature of the color?*

It is a deep red, or scarlet, but the color is not so brilliant as that obtained from the cochineal.

*Q. In what does it differ from the scarlet from cochineal?*

A. It is much more durable, and less subject to stain or blemish.

*Q. For what is it chiefly used?*

A. To dye coarse cloths that are made of wool.

*Q. Can cotton or linen cloths be dyed of a scarlet color?*

A. No; no coloring matter has yet been found that will do so.

*Q. What is cochineal?*

A. An insect peculiar to Mexico, living on a plant called the cactus.

*Q. For what is it used?*

A. For the purpose of making crimson and lake pigments, and for dyeing the most brilliant scarlets on wool.

*Q. What is shell-lac?*

A. The product of an insect found in the East Indies; it is used for the making of sealing-wax, and for dyeing inferior scarlets on wool.

## LESSON CVIII.

*Q. What is sepia?*

A. A brown color obtained from the cuttle-fish.

*Q. What use is made of it?*

A. It is used as a pigment for picture painting.

*Q. How is it obtained?*

A. It is found in a bag in the interior of the fish.

*Q. What is Prussian blue?*

A. A beautiful pigment obtained by means of chemistry from the refuse of animals, as hoofs, horns and blood.

*Q. For what is it used?*

A. As a purple paint, and to dye fabrics of blue and purple colors.

*Q. From what did the ancients derive their purple?*

A. From a shell-fish, now called the buccinum.

*Q. How was the color obtained?*

A. By steeping the material in the juice pressed from the fish, and then exposing the cloth to the air.

*Q. By whom was this color worn?*

A. It was the badge of royalty and power.

*Q. What name was given to this color?*

A. It was the celebrated Tyrian purple.

*Q. Of what color was it?*

A. A deep, dark red.

*Q. Is this color now in use?*

A. No; brighter and richer colors are now obtained from better and more agreeable materials.

## LESSON CIX.

*Q. What are mineral colors?*

A. Those that are derived from earth, metal, or rock.

*Q. What colors are obtained from earths?*

A. Various colors, as red, yellow and other colored ochers.

*Q. What are ochers?*
A. Very fine clays which obtain their various colors by being mingled with the oxyds of some metal.

*Q. For what are they used?*
A. For coloring walls, paper-hangings of the common description, and for other rough coloring.

*Q. What colors are obtained from rocks?*
A. Two of the most brilliant with which we are acquainted.

*Q. What are their names?*
A. Ultra-marine and chrome.

*Q. What is ultra-marine?*
A. It is a blue color used as a paint for the finest pictures, and porcelain.

*Q. Whence is it obtained?*
A. From a beautiful stone, called lapis lazuli, which is found in Persia and China.

*Q. For what is it valued?*
A. For a brilliant blue that no other material will approach.

*Q. Is it of much value?*
A. Yes; it is truly worth its weight in gold.

## LESSON CX.

*Q. What colors are extracted from metals?*
A. Colors of every hue, from vermilion to white.

*Q. How are they obtained?*
A. Mostly from the action of fire, or an acid, upon metals.

*Q. What is vermilion?*
A. A brilliant scarlet pigment; it is produced by the action of heat upon a mixture of sulphur and mercury.

*Q. For what is it used?*
A. As a scarlet paint, and to give a bright color to sealing-wax.

*Q. What colors are produced from lead?*
A. White lead and red lead.

*Q. What is white lead?*
A. A white oxyd obtained from lead by the action of vinegar upon it.

*Q. For what is it used?*
A. Chiefly as a base for colored paints.

*Q. Why are houses and ships painted?*
A. To give greater beauty to the structure, and to preserve the surface from the action of the weather.

*Q. How does paint preserve the wood?*
A. It covers the surface with a metallic covering, mingled with oil.

*Q. What is red lead?*
A. A red oxyd formed upon the surface of lead, when in a state of fusion, by passing over it a current of air.

## LESSON CXI.

*Q. Of what color are the oxyds of gold?*
A. Of a dark, rich red and purple.

*Q. For what purposes are they used?*
A. To color glass and porcelain of the richest warmest colors.

*Q. Why are mineral colors always used for coloring glass and porcelain?*

A. Because colors upon these materials must be burnt in, and none but mineral colors will stand the heat.

*Q. Why will not vegetable colors answer?*

A. The heat would dissipate and destroy the color.

*Q. Why?*

A. Because all vegetable colors are very fugitive; that is, they are destroyed by heat.

*Q. From what are mineral greens derived?*

A. Chiefly from copper.

*Q. What is cobalt?*

A. A blue pigment made from a metal of the same name.

*Q. For what is it used?*

A. For giving a blue tint to glass and china.

*Q. Of what colors are the oxyds of iron?*

A. They are all of a brown shade.

*Q. For what are the oxyds of iron used?*

A. Mostly as a mordant for other colors.

*Q. Can you name any oxyds used as mordants?*

A. Copperas and blue vitriol are used for that purpose.

## LESSON CXII.

*Q. What is a mordant?*

A. The oxyd, or salt of some metal, used to fix and heighten the various substances used to dye fabrics of different colors.

*Q. What is the meaning of the word?*

A. It is a French word, and means to b

biting; that is, it eats into every fiber of the material that may be steeped in it.

*Q. Which are the principal mordants?*

A. Those prepared from alumina (alum), iron and tin.

*Q. How are those mordants prepared?*

A. The metals are dissolved in acids.

*Q. Can colors be fixed without a mordant?*

A. No; the fabrics silk, cotton, wool, etc., would only be stained of a dingy color, very unevenly distributed, and very fugitive.

*Q. What substances are chiefly used for dyeing?*

A. Mostly those of a vegetable origin.

*Q. Can you name any?*

A. Madder, indigo, brazil-wood, logwood, ebony, safflower, fustic, archil, galls, and others.

*Q. What is madder?*

A. A deep-red color prepared from a root with which to dye reds and browns.

*Q. What is ebony?*

A. A very hard and heavy wood from which a deep yellow is extracted, principally used as a base for other colors, as dark browns and greens.

## LESSON CXIII.

*Q. What is indigo?*

A. A blue pigment, obtained after much labor, from a plant growing in the tropical parts of Asia and America.

[illegible] *For what is it used?*

[illegible] For dyeing permanent dark blues on wool [illegible]on, [illegible] bright blues on silk.

*Q. What is brazil-wood?*

A. A wood brought from the West Indies and South America; it is used chiefly as a crimson dye for silk, but is very fugitive.

*Q. What is logwood?*

A. A well-known wood, brought from the tropical parts of America, and is much used for dyeing black colors.

*Q. What is fustic?*

A. An American wood used to give a yellow base for other colors.

*Q. What is archil?*

A. A very valuable die produced from a lichen growing on the rocks in the Canaries. It gives a purple color.

*Q. What are galls?*

A. Nut-galls are the produce of a species of oak tree growing in Turkey. They are chiefly used in the making of writing-ink.

*Q. What is safflower?*

A. The dried leaves of a flower growing in the hot parts of Asia; it is used as a pink dye for silk, also rouge is made from it, with which ladies, sometimes, color their faces.

## LESSON CXIV.

*Q. Why are mineral colors used in coloring glass and china?*

A. Because those colors have to be burnt in by being baked in a highly heated oven.

*Q. How would this process affect vegetable or animal colors?*

A. The heat would destroy them.

*Q. Where was porcelain first made?*

A. The Chinese were the first inventors of china, or porcelain.

*Q. Of what color is the porcelain of China?*

A. Chiefly blue, which color they obtained from cobalt.

*Q. When was porcelain first seen in Europe?*

A. It began to be used by the wealthy during the sixteenth century, soon after the discovery of a passage to China by sea.

*Q. Previous to that, what was used in its place?*

A. Trenchers, or wooden plates, or at best, plates made of pewter, but the latter, from their cost, could only be used by the rich.

*Q. Why was not silver plate used?*

A. Previous to the discovery of America, gold and silver were very scarce, and were only used for coining money, personal ornaments and church purposes.

*Q. Where were shawls first made?*

A. Shawls first brought from India were the finest, and those of the most brilliant colors continue still to be made there.

*Q. Where were printed calicoes first made?*

A. In India; they were brought from Calicut; hence the name calico.

*Q. Whence do we derive the words "shawl and calico?"*

A. We derive both from India, the country we call Hindostan.

## FUEL.

### LESSON CXV.

*Q. What is fuel?*
A. A substance used for creating artificial heat.

*Q. What materials are used in this country for that purpose?*
A. Coal and wood.

*Q. Upon what does the prosperity of a country depend?*
A. Upon the quantity of fuel it possesses.

*Q. Why?*
A. Because, for domestic, manufacturing and mechanical purposes, an unlimited amount of fuel is necessary.

*Q. What is meant by mechanical purposes?*
A. The driving of steam engines and steamships.

*Q. Which is the more valuable fuel?*
A. Coal.

*Q. What is coal?*
A. The remains of antediluvian forests.

*Q. Whence is coal obtained?*
A. From mines in various parts of the world.

*Q. Why is coal the more valuable?*
A. Because it contains the most fuel in the least space.

*Q. Could steamships cross the ocean without coal?*
A. No; they could not carry enough fuel.

## CXVI.

without coal?
the supply of
exhausted.

the land will
building purposes

is making one ton

that can be
three acres of

the manufac-
the south-
the poor of

charcoal?
Sweden, France

## LESSON CXVII.

*Q. When was iron first smelted by means of coal?*

A. In England, in the year 1740, by an invention of Lord Dudley.

*Q. What has been the result?*

A. From manufacturing a few thousand tons a year, the English now export over one million tons.

*Q. Is the supply limited?*

A. Only by the demand; the United States could supply the world.

*Q. Why?*

A. Because here iron ore and coal exist in unlimited quantities.

*Q. What countries are best supplied with coal?*

A. The United States and England.

*Q. Which are the principal descriptions of coal?*

A. Bituminous and anthracite coals.

*Q. What is bituminous coal?*

A. That which contains tar; it burns with a flame.

*Q. Which is anthracite?*

A. The hard, or stone coal, which burns without a flame.

*Q. From which is gas manufactured?*

A. From bituminous coal.

*Q. What is coke?*

A. The refuse of coal from which gas has been obtained.

## LESSON CXVIII.

*Q. Whence is anthracite coal obtained?*

A. The Eastern and Middle States are supplied with coal by Pennsylvania.

*Q. Whence comes bituminous coal?*

A. It is imported from England.

*Q. What is peat?*

A. A fibrous mass of vegetable matter cut from bogs, and swampy places, like sods of grass.

*Q. How is it prepared?*

A. It is cut in summer, placed out to dry, and stacked away for fuel.

*Q. Where is it mostly used?*

A. In Ireland, Holland, and other countries where wood and coal are scarce.

*Q. What is the principal fuel used in France and Spain?*

A. Charcoal in the large cities.

*Q. What is the consequence?*

A. Fuel is very costly, and can only be used, except for cooking purposes, by the wealthy.

*Q. What kind of fuel is used in the extreme north?*

A. Oil obtained from the whale, seal, walrus, and other animals; it is burnt in lamps.

*Q. What is used for fuel by the Arabs?*

A. The dried dung of the camel, and even the bones of animals.

# GUMS AND RESINS.

## LESSON CXIX.

*Q. What are gums?*
A. The sap of certain plants and trees, that exudes from the bark and concretes by the action of the atmosphere.

*Q. What is gum-arabic?*
A. It is the purest description of gum, and is produced from a tree growing in the northern parts of Africa.

*Q. What is gum-copal?*
A. It is a strong, heavy gum, produced in the tropical parts of America and Asia.

*Q. For what is it used?*
A. To make varnish.

*Q. What is tragacanth?*
A. A gum brought from Africa, which forms an excellent paste when put into a bottle of water.

*Q. What is gamboge?*
A. A gum brought from Ceylon; it is chiefly used as a paint, and for patent pills.

*Q. What is camphor?*
A. A gum obtained by distillation from a laurel growing in Japan.

*Q. For what is it used?*
A. We use it as a medicine, but in the East it is often formed into candles, and burnt as a light.

Q. What is opium?
A. The gum of a poppy growing in India, Egypt, and Turkey.

Q. For what is it used?
A. As a medicine; laudanum and morphine are prepared from it.

## LESSON CXX.

Q. What is India-rubber?
A. The thickened sap of a variety of plants growing in India and South America.

Q. What is gutta-percha?
A. A substance brought from Malacca, similar in appearance to India-rubber, but it becomes plastic in boiling water.

Q. What is turpentine?
A. A resinous gum obtained from the fir-tree.

Q. What is rosin?
A. The refuse of turpentine from which the spirit is extracted.

Q. What is myrrh?
A. A very bitter gum from Arabia; it is used as a medicine, and for a certain fragrance when burnt.

Q. What is frankincense?
A. An Arabian gum used as an odor when burnt.

Q. What is amber?
A. A resinous gum found on the shores of the Baltic; it is used for varnish and for ornament.

*Q. What regions produce the finest gums?*
A. The most valuable are produced in the hottest parts of the earth.

*Q. What are the chief features of resins?*
A. A resin will not dissolve in water; it is also inflammable.

*Q. What are those of gum?*
A. Gum will dissolve in water; it will not burn.

◆

## SILK.

### LESSON CXXI.

*Q. What is silk?*
A. An extremely fine fabric exuded by an insect called the silkworm.

*Q. Why does the caterpillar spin this fiber?*
A. To form a bed for itself while in a state of transformation.

*Q. To what purpose does man apply this material?*
A. To supply himself with a covering, the most brilliant of all his clothing.

*Q. Whence was silk first obtained?*
A. China is supposed to be the native country of the silkworm.

*Q. When was silk first known in Europe?*
A. Not until the age of the first emperors of Rome.

*Q. How did the Romans become acquainted with silk?*
A. As the tide of conquest rolled east

the Romans became acquainted with new customs and new materials for dress.

*Q. What effect had their conquest upon them?*
A. They looked upon the new clothing with desire.

*Q. How did the Romans obtain their silk?*
A. They purchased the silk cloth at a great price.

*Q. What was the price of silk then?*
A. A pound of silk was sold for a pound of gold.

*Q. Was this thought to be extravagant?*
A. Yes; many laws were made to prohibit its importation and use.

## LESSON CXXII.

*Q. Were these of any effect?*
A. No; silk was smuggled into the land and worn.

*Q. How was this state of things met?*
A. A law was passed confining the use of silk to women, and making it infamous for a man to wear it.

*Q. Had those laws any effect?*
A. No; in the year 220 the Emperor Elagabalus entered Rome in triumph, dressed in robes of pure silk; the first ever seen in Europe.

*Q. What was the effect of this?*
A. After such an example, every sumptuary law upon the subject became void.

*Q. What then became the limit of wearing silk?*
A. The limit stopped with the means.

*Q. By whom was silk worn?*
A. The wealthy exposed their silken robes to the wondering gaze of the multitude.

*Q. What did the less affluent do?*
A. They contented themselves with some of the precious filaments woven with the baser threads of linen.

*Q. How were the silk threads woven with linen?*
A. The silks of China were unraveled and again woven with threads of linen.

*Q. Did the silk undergo any other process?*
A. Yes; it was unraveled and made into a fine gauze to make the most of a small quantity.

*Q. To what extent was this practice carried?*
A. It was a very lucrative trade among the Phœnician women during the first five centuries of the Christian era.

## LESSON CXXIII.

*Q. When was silk first cultivated in the West?*
A. The silkworm was first introduced into Europe by the Emperor Justinian, about the year 550.

*Q. How were they obtained?*
A. Some Christian priests of Persia succeeded, after many trials, in carrying from China some of the eggs of the silkworm.

*Q. How did they accomplish this?*
A. By hollowing out their walking-staves and placing the eggs inside.

*Q. Where was silk first raised in Europe?*
A. In Greece; under the direction of the same priests the eggs were hatched and the worms reared.

*Q. Did the occupation flourish?*
A. Yes; for many ages the culture of silk was the most flourishing business of the eastern empire of Rome.

*Q. Where is silk now manufactured?*
A. In most civilized countries, but Lyons, in France, is the principal mart.

## POISONS.

### LESSON CXXIV.

*Q. What are poisons?*
A. Substances that are destructive to life.

*Q. Where do they exist?*
A. In all divisions of nature, animal, vegetable, mineral and gaseous.

*Q. Are the elements noxious?*
A. All the simple substances are deadly poisons.

Q. *What are the medicines?*
[illegible] They are all poisons, and hence their vio-[illegible]tion.

*Q. Why have medicines a nauseous taste?*

A. To warn of danger, that they may not be too freely used.

*Q. What was the primary meaning of the word medicine?*

A. The word originally meant a poison.

*Q. What poisons exist in the air?*

A. Those that cause fevers, cholera, the plague, small-pox, and other deadly diseases.

*Q. From what do fevers mostly arise?*

A. From a vitiated, or foul atmosphere, caused by want of cleanliness, or proper ventilation.

*Q. At what season do they prevail?*

A. Mostly during winter, in crowded, ill-ventilated houses and ships.

*Q. Does the yellow fever so arise?*

A. No; that arises from poisonous exhalations from swampy lands near the sea within the tropics.

## LESSON CXXV.

*Q. To which hemisphere is the yellow fever confined?*

A. It is a disease peculiar to the western continent, but it has been carried to Spain and Italy by ships, and become epidemic.

*Q. What is the meaning of an epidemic disease?*

A. It means, generally prevailing, or one that can be communicated by contagion, as the cholera, and some fevers.

*Q. What is an endemic disease?*

A. One confined to a particular locality, as the ague. It is not contagious.

*Q. In what region have all the great plagues arisen?*

A. On the banks of the great rivers of southern Asia.

*Q. What names are given to them?*

A. The plague, small-pox, and cholera.

*Q. What is supposed to have been their origin?*

A. Some invisible poison in the atmosphere.

*Q. To what country is the plague now confined?*

A. Chiefly to the northern part of Egypt.

*Q. Was it formerly more prevalent?*

A. Yes; during the middle ages it frequently swept through Europe and Asia, and carried off millions of people.

*Q. When did the small-pox first appear?*

A. During the sixteenth century, and being a new disease, decimated the human race.

*Q. When did the cholera first appear?*

A. In 1816, on the banks of the Ganges in India.

## LESSON CXXVI.

*Q. What are animal poisons?*

A. Those that cause inflammation and death to ensue from a bite, or other wound by an animal.

*Q. What animals are poisonous?*

A. Nearly all the serpents and snakes, scor- [illegible] many insects.

*Q. Why are snakes poisonous?*
A. They are rendered poisonous as a means of defense; without it they are helpless in case of attack.

*Q. When do they exert their poison?*
A. Only in cases of danger.

*Q. How does the poison act?*
A. Only by being mixed with the blood through a wound; it then causes rapid inflammation, and death.

*Q. What is the result if the poison be swallowed?*
A. It is perfectly harmless.

*Q. What insects are poisonous?*
A. Bees, hornets, wasps, and some others, are armed with a poisonous sting for self-defense.

*Q. What is the hydrophobia?*
A. A fatal disease arising from the bite of a dog, or other animal, when under the influence of certain diseases.

*Q. What animal is the most subject to this disease?*
A. It originates with dogs and wolves.

## LESSON CXXVII.

*Q. Which are the principal vegetable poisons?*
A. The most common are strychnine, opiu prussic acid, and oxalic acid.

*Q. From what is strychnine obtained?*
A. This most terrific poison is obtained from the seed of a tree growing in the East Indies.

*Q. How is it obtained?*

A. By distilling the seeds with diluted sulphuric acid.

*Q. What is the appearance of this poison?*

A. It consists of small, white, brilliant crystals.

*Q. What are its effects?*

A. A single grain will destroy life by convulsions in a few minutes.

*Q. What is opium?*

A. A gum obtained from a poppy growing in India.

*Q. What is prussic acid?*

A. It can be obtained by distilling bitter almonds, but is generally made from a preparation of mercury.

*Q. What is oxalic acid?*

A. A salt obtained from sugar and nitric acid.

*Q. What are mineral poisons?*

A. They are very numerous, and chiefly obtained from the oxyds of metals.

*Q. Which are the most common?*

A. Oxyds of arsenic, mercury, antimony, lead and copper.

## LESSON CXXVIII.

*Q. How do poisons act on man?*

ost of them act locally.

*t is meant by that?*

destroy the parts with which they
nmediate contact.

*Q. Can you give an instance?*

A. Sulphuric, and other mineral acids, burn away, and destroy, whatever part of the body they may touch.

*Q. How does arsenic act?*

A. In a similar manner; slowly, but surely, burning through the intestines of its victim.

*Q. Are the nerves and brain affected?*

A. No; the sufferer is conscious, and has a dreadful sense of burning to death by a fire that no water can quench, or medicine alleviate.

*Q. What poisons act thus?*

A. All the mineral poisons.

*Q. What poisons act on the nerves?*

A. Strychnine is the most powerful.

*Q. How is the body affected?*

A. The features are hideously distorted, the head and body being bent forcibly back; the victim presents a horrible aspect of exquisite torture.

*Q. What poisons affect the brain?*

A. Prussic acid is the most powerful.

*Q. What are its effects?*

A. Similar to a violent blow on the head; the whole body becomes paralyzed.

## LESSON CXXIX.

*Q. What poisons act upon the lungs?*

A. Tartar emetic, which causes the lungs to expand and inflame, and death ensues from suffocation.

*Q. What poison affects the heart?*

A. Oxalic acid; its action is directly

circulation of the blood, and hence the heart is affected, and the vital action ceases from fainting and exhaustion.

*Q. What is hemlock?*

A. A deadly poison obtained from a plant growing in swampy or damp situations.

*Q. Why is it famous?*

A. Because it was the public executioner among the ancient Greeks.

*Q. What are its effects?*

A. It affects the brain, spine, and nerves; paralysis, stupefaction and death follow quickly in succession.

*Q. Where are poisoned weapons used?*

A. Among many tribes in South America, Africa, and the islands of the Pacific.

*Q. Why do they poison their arrows, etc.?*

A. Because of the feeble, and, otherwise, almost harmless nature of their weapons.

*Q. Whence are obtained the strongest poisons?*

A. Animal and vegetable poisons attain their greatest virulency and intensity in the hottest climates of the earth.

◆

## PAPER.

### LESSON CXXX.

*Q. What is paper?*

A. A well-known substance made from linen or cotton rags, to write or print upon.

*Q. From what does it derive its name?*

A. From the word papyrus, the name of a

reed growing on the banks of the Nile in Egypt, from which paper was first made.

*Q. How long has the art of making paper been known?*

A. We have papyrus, taken from the tombs of Egypt, three thousand years old.

*Q. Is the papyrus a similar material with the paper of the present day?*

A. No; it consists of long, narrow strips of a brown fabric, upon which figures were painted, or words written by a style, or pen.

*Q. Was this kind of paper long in use?*

A. Yes; it formed one of the principal sources of wealth to Alexandria, in Egypt, for many ages.

*Q. How long did it continue to be used?*

A. It was used in western Europe until the tenth century.

*Q. Upon what were public records written?*

A. The laws were often engraved upon slabs of stone, or metal, and exposed in the market place, or some other place of public resort.

*Q. Of what were school books often made?*

A. In the early times of Greece, the lessons were engraved on sheets of lead.

*Q. Upon what were books written?*

A. Upon parchment, or vellum, substances prepared from the skins of sheep and asses.

## LESSON CXXXI.

*Q. By whom was real paper invented?*

A. By the Chinese, or Hindoos, in very early times.

*Q. Of what was it made?*

A. Of cotton.

*Q. By whom was it introduced into Europe?*

A. By the Arabs, about the ninth century.

*Q. When was paper first made of linen?*

A. During the thirteenth century.

*Q. When was the first paper made in England?*

A. In the year 1588, by a German named Spilman.

*Q. Of what is the best writing-paper made?*

A. Of linen rags, which are the fine fibers of flax.

*Q. Why is paper made generally from rags?*

A. Because, in the process of making the flax and cotton into a fabric, the fibers become minutely separated.

*Q. Why must paper be made of a fibrous substance?*

A. Because the fibers, when highly separated, twist and mingle together, and will hold fast to each other when spread out into a thin sheet.

*Q. Why is the best paper made of linen rags?*

A. Because linen produces the finest and most solid fiber.

*Q. What is a manuscript?*

A. A book, or part of a book, written with a pen.

## SALT.

### LESSON CXXXII.

*Q. What is salt?*

A. It consists of white crystals obtained from the waters of the ocean, from salt springs, or from salt mines.

*Q. Are all the waters of the ocean salt?*

A. Yes; in all parts of the ocean the waters are salt.

*Q. What are salt mines?*

A. They are vast beds of solid, or rock salt, found in the earth.

*Q. How are they supposed to have come there?*

A. By the gradual drying up of all salt lakes.

*Q. What are salt springs?*

A. Springs of water that flow through those beds of salt.

*Q. Whence do we obtain most of the salt we use?*

A. Mostly from salt springs.

*Q. How is it obtained?*

A. By pumping up the brine into shallow vats or boilers.

*Q. What is then done with the brine?*

A. A slow fire is made under the vat to drive off some of the water.

*Q. What does that do?*

A. A certain portion of water will only dissolve a certain portion of salt.

*Q. What then takes place?*

A. When the brine that is left becomes

a portion of the salt falls to the bottom, when it is raked out and dried.

*Q. How is salt obtained from the ocean?*

A. Large, shallow trenches are made in the ground, and water from the ocean let in; the aperture is closed, and the sun does the work of the fire.

## LESSON CXXXIII.

*Q. Where is salt so made?*

A. Mostly in very hot countries.

*Q. Which is the best salt?*

A. That made from salt springs.

*Q. Why is that?*

A. Because the water, in flowing through the bed of salt, dissolves the salt and leaves most of the impurities behind.

*Q. Is sea salt pure?*

A. No, it contains lime and other substances.

*Q. Is that of any consequence?*

A. Yes, in curing meat it is of very great importance.

*Q. Is salt of much use?*

A. Yes; it is one of the necessities of life.

*Q. How is that?*

A. It flavors our food, and renders it wholesome.

*Q. How are meats preserved?*

A. By means of salt.

*What is the chief value of salted meats?*

They can be kept a long time, and be sent

stances.

# GLOSSARY.

## GLOSSARY—EXPLANATION OF SCIENTIFIC TERMS.

### SCIENCES.

**ASTRONOMY**, a discourse about the stars, and the laws that govern them.

**ANATOMY**, a discourse about the bones, and other internal parts of the body.

**CHEMISTRY**, the science which discovers of what elements a material is composed.

**BOTANY**, the science which describes and classifies plants.

**GEOGRAPHY**, the science which describes the surface of the earth.

**GEOLOGY**, the science which describes the structure of the interior of the earth.

**GEOMETRY**, the science of measuring space within certain figures or angles.

**CHRONOLOGY**, the science which treats of the divisions of time, and the dates of the great events in history.

**CONCHOLOGY**, a discourse about shells, their formation and classification.

**ENTOMOLOGY**, a discourse about insects; their forms, habits and arrangement.

**ZOOLOGY**, the science which classifies animals into various orders, according to their habits and conformation.

**ORNITHOLOGY**, a discourse about birds.

**THEOLOGY**, the science of divine things, or religion.

**SCOPE**, to see, to reach, to measure.

**TELESCOPE**, an instrument for the purpose of viewing dist jects.

**MICROSCOPE**, an instrument to view minute objects.

[illegible] ot or [illegible].

[illegible] an instrument to measure the [illegible]

[illegible]

[illegible] an instrument used in laying out the [illegible]

[illegible] on a flat surface.

[illegible] an instrument that causes fragments of glass [illegible]

[illegible]

[illegible] a telescope to view the sun without injury to [illegible]

[illegible]

[illegible]

[illegible] an instrument to measure the heat of the [illegible]

[illegible]

[illegible] an instrument to measure the weight of [illegible]

[illegible]

[illegible] an instrument to measure the degree of heat [illegible]

[illegible]

[illegible] an instrument to measure time.

[illegible] through the center.

[illegible] an instrument to measure the expenditure of gas.

[illegible] an instrument to measure the density of fluids.

[illegible] the art of short-hand writing, or of using sy[illegible]

[illegible]

[illegible] light-painting, or pictures taken by means o[illegible]

[illegible]

[illegible] for the [illegible]

[illegible] in a state of rest.

[illegible] the origin and effect [illegible]

[illegible]

[illegible] determined by the [illegible]-

[illegible] of the brain.

[illegible] character from the [illegible]-

[illegible]

[illegible] motion.

[illegible] vision.

[illegible] creation of electr[illegible]-

[illegible]s.

[illegible] atmosphere, and the

[illegible]

METALLURGY, the science of separating metals from their various oxyds.

ICHTHYOLOGY, a discourse about fishes.

MINERALOGY, the classification of minerals.

PHILOSOPHY, a general name for learning, or general knowledge.

BIOGRAPHY, a history of the lives and actions of celebrated men.

PHYSIOLOGY, a description of the particular construction, and functions of the various portions of animals and plants.

AGRICULTURE, the science of cultivating the earth.

ARCHITECTURE, the science of constructing buildings.

ELECTRICITY, the science which describes the laws which produce and govern the electric fluid.

MAGNETISM, the science which treats of the influence and effects of the magnet.

PNEUMATICS, the science which treats of the mechanical laws that govern the atmosphere.

PHYSICS, natural laws which govern the properties of bodies.

HYDROSTATICS, the science which treats of the mechanical pressure of water.

HYDRAULICS, the science of conveying water through pipes, etc.

GRAPH, to describe, to write, to represent by drawing lines.

AUTOGRAPH, the name of a person, self-written.

ORTHOGRAPHY, correct writing, or spelling.

GRAPHIC, well and truly described.

APOGRAPH, a copy.

CALIGRAPHY, the art of beautiful writing.

COSMOGRAPHY, the science which treats of the construction and arrangement of all parts of the world.

EPIGRAM, a few lines of great wit, or force.

TELEGRAPH, an instrument to record signals.

LITHOGRAPHY, writing on stone.

TYPE, a likeness, an emblem, like the original.

ANTITYPE, a pattern, a model, an exact likeness.

PROTOTYPE, a first, or original model.

STEREOTYPE, solid masses of letters, taken from a mold in which an exact representation of the type has been made

Transparent, clear, objects can be seen through it.
Reflective, throwing back light, or figures, like a looking-glass.
Natural, formed in its present state by nature.
Artificial, shaped by art.
Dormant, in a state of sleep.
Extrinsic, on the surface, or outside.
Concave, hollow, like a saucer.
Convex, bulging out, like an orange.
Isolated, cut off, having no communication.
Insulated, separated from other objects by means of a non-conductor.
Vesicular.
Vitreous, like glass.
Fluid, the particles do not cohere, or hold together.
Clear, without blemish or stain.
Colorless, without color, or tint.
Liquid, in a fluid state.
Incompressible, not to be pressed into a smaller compass.
Wholesome, good for food.
Tasteless, void of taste.
Inodorous, without scent.
Solvent, dissolving in a fluid.
Inanimate, without life.
Penetrating, entering into every pore.
Purifying, making pure, or clean.
Fertilizing, causing to grow.
Solid, of the same substance throughout.
Fibrous, made up of small threads.
Adamantine, of extreme hardness.
Analysis, the resolving a substance into its original parts.
Armature, the natural weapons or protectors of an animal or plant, body armor.
Buoyant, light, floating in water.
Collapsed, fallen in.
Annealed, tempered, and made less brittle by heat.
Essence, the chief quality extracted by distillation.
Tincture, the virtue of a plant, root, or seed, obtained by of a solvent.

Vacuum, a space from which all the air has been extracted.
Helix, winding like a screw.
Momentum, force or power of motion.
Chromatic, relating to color.
Chronic, of long standing.
Endemic, among the people, local, confined to a particular place, as the ague.
Epidemic, generally prevailing, diffused.
Contagious, communicating by contact.
Decimated, a tenth part taken away.
Eliminated, cast out as needless.
Bulbous, round, formed in layers, like an onion.
Farinaceous, containing flour, or meal.
Succulent, full of juice.
Calcined, burnt in a closed vessel.
Ligneous, woody, dry, hard.

THE END.

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*Any of the above sent* [illegible]